Original article

ABC-VEN matrix analysis of pharmaceutical inventory management in Tikur Anbessa Specialized Hospital for the years 2009 to 2013, Addis Ababa, Ethiopia

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Abstract

Introduction: Effective drug supply management ensures uninterrupted availability of quality approved, safe and effective pharmaceuticals. This can be achieved through proper selection, quantification, procurement, distribution and use of drugs based on consumption and morbidity pattern of the catchment area by using a system like ABC-VEN matrix analysis. The objective of the study was to assess pharmaceutical inventory management of Tikur Anbessa Specialized Hospital (TASH) for fiscal years 2009-2013.

Methods: This research was retrospective facility based cross sectional study in which ABC, VEN and ABC-VEN matrix analysis techniques were utilized to assess the 5 years (2009-2013) pharmaceutical inventory management system at TASH. The study was conducted from January - May 2014.The list of drugs with corresponding prices was retrieved from goods receiving vouchers, GRV (models 19).

Observations and results: Out of the five years pharmaceutical ABC analysis; Insulin /NPH/, examination glove, gauze bandage, surgical gloves, vicryl and normal saline 1000 ml had exist through five years by covering huge amount of money. From ABC-VEN matrix analysis, majority of items were Category I. Most of the Category I pharmaceuticals in turn were Class A and V items which require great attention for their control and availability.

Conclusion: The study findings indicated that there are huge pharmaceuticals in TASH, which need proper control and supervision at different levels of management. The results indicate the need for routine application of scientific pharmaceutical inventory management tools such as ABC-VEN matrix analysis to improve efficiency of resource use and patient care.

Key words: ABC analysis, VEN analysis, ABC-VEN matrix, Class I, Class II, Class III Pharmaceuticals

Introduction

In different countries majority of health facilities budget is spent for pharmaceuticals utilization. Spending on pharmaceuticals accounted for more than 17% of all health expenditure on average across Organization for Economic Cooperation and Development (OECD) countries in 2011.[1] Effective management on availability and accessibility of essential drugs as well as alternative drugs with information particularly in pharmacy profession are found to be crucial for optimal and rational pharmacotherapy.[2] This could be achieved through proper selection, quantification, procurement, distribution and use of drugs based on consumption and morbidity pattern of the catchment area.[3] Thus, the need for planning, designing and organizing the pharmacy in a manner that results in efficient clinical and administrative services becomes the most pertinent.[4] The goal of the hospital supply system is to ensure that there is adequate stock of the required items so that an uninterrupted supply of all essential items is maintained.[5] There are various tools involved for inventory management but commonly used are: Always, Better, and Control (ABC)

and Vital, essential and Desirable/ Non essential (VED/N) and Stock card & Bin card.[6,4,7]

ABC analysis is a method of classifying items according to their cost. It is also known as the V.Pareto principle [8] "separating the vital few from the trivial many" because, for any group of things that contribute to a common effect, a relatively few contributors account for a majority of the effects. The analysis classifies the items into three categories: the first 10-20% of the items account for approximately 70-80% of cumulative value (cost) (category A), 10-20% are category B items that account for a further 15-20% of the cumulative value and the remaining 60-80% are category C items, amounting for a mere 5-10% of the total value.[9,10,11,12]

The limitation of ABC analysis is that it is based only on monetary value and the rate of consumption of the item. In a hospital, an item of low monetary value and consumption may be very vital or even lifesaving. Their importance cannot be overlooked simply because they do not appear in category A. Therefore, another parameter of the materials is their criticality.

VEN analysis of pharmaceuticals is based on criticality and utility for the patients. Based on their criticality, the items could be classified into three categories: vital, essential and desirable.[5] The categories in the original system are vital (V), essential (E), and nonessential (N) (sometimes called VED-vital, essential, and desirable).[13,14] Vital pharmaceuticals can be given values based on their potential on lifesaving, crucial for health services and if it is impossible without them to safely alive and prevent death or disability of the patient. It is mandatory 24 hours of a day, 7 days of a week, a quarter of a year or 12 months of a year.[11] Essential pharmaceuticals are effective against less severe but significant illness, not vital; it is between Vital and less essential .They are lifesaving ; without which patient may be in difficulty but may be somehow substituted. It is mandatory at least once a day, or at least once in a week, or at least once in a month or once in a quarter of the year, but not as highly mandatory as vitals. [11] Non-essential/less essential pharmaceuticals are effective for minor illnesses and low therapeutic advantage. These items are important to patients; however, patients will not die or face a traumatic condition due to the absence of these drugs/ reagents. So they are not essential.[11,15]

The pervious ABC-VEN analysis done in TASH [16] has certain limitations; the data was only three years, lacks matrix analysis and it was done by mixing Aid & Budget pharmaceuticals. For this reason, expensive Aid pharmaceuticals make dominancy over some Budgets which might be class A item if it was done separately. Moreover, study is needed which indicates current pharmaceutical managerial activities. **Aims & Aims & Objectives**

The objectives of this study was to analyze TASH pharmaceuticals inventories from 2009 - 2013 by using ABC-VEN matrix, and to assess five years pharmaceuticals consumption trend as well as to identify categories of pharmaceuticals requiring stringent management control.

Materials & Methods

Study setting and design

The study was carried out at Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia. TASH is a teaching hospital of Addis Ababa University which has more than 700 beds and serves more than 818 patients per day on outpatient pharmacy service. Majority of these patients receive a prescription containing one or more drugs [17] This research was retrospective facility based cross sectional study in which ABC, VEN and ABC-VEN matrix analysis techniques were utilized to assess the 5 years (2009-2013) pharmaceutical inventory management system by using hospital's secondary GRV data (model 19) from January-May 2014.

Inclusion and exclusion criteria

Pharmaceuticals i.e., drugs, laboratory reagents and consumable medical supplies that are purchased by hospital or donated to the hospital and recorded by good receiving vouchers (Model 19) from 2009 to 2013 were included (Appendix 1) All program pharmaceuticals like; antiretroviral drugs, anti-tuberculosis drugs, family planning drugs and Implantable pharmaceutical equipment were excluded from this study.

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Data collection and analysis

The data was collected from model 19 by trained pharmacists. The training focused on pharmaceuticals with same name but with different strength and dosage. Each pharmaceutical was recorded on the data abstraction form. The data analysis had three phases; the first was ABC analysis which had nine steps (Appendix 2). VEN analysis was the second phase which needed only reconciliation hence it was done based on the hospital drug list which included VEN analysis. The final but crucial step was ABC-VEN matrix analysis after reconciliation. The ABC-VEN matrix was formulated by cross-tabulating the ABC and VEN analysis. From this combination, three categories were created (I, II and III). Category I was constituted by drugs belonging to AV, AE, AN, BV and CV subcategories. The BE, CE and BN subcategories constituted category II, and the remaining drugs in the CN subcategory constituted category III. In these subcategories the first alphabet refers to its place in ABC analysis, while the second alphabet stands for its place in the VEN analysis.[18,19,15,4]

Observations & results

ABC analysis

The five years ABC analysis of pharmaceuticals in TASH is summarized in Table 1. The ABC analysis of Tikur Anbessa Specialized Hospital showed that a total of 250 items were stored during the year 2009 which increased in successive years. Out of these pharmaceuticals, 24 items (9.60%) consumed 81.20% of annual drug expenditure comprising group 'A' items. Fifty one items (20.40%) consumed 13.30% of annual drug expenditure forming group 'B' items. The rest 175 items (70.00%) consumed only 5.50% of total budget, classified as group 'C' items. In 2013, 263 items were analyzed out of which 32 items (12.17%) consumed 76.15% (18, 466, 329.04 Birr) of annual pharmaceuticals expenditure comprising group 'A' items and 47 items (17.87%) consumed 15.63% (3,779, 223.45 Birr) of annual drug expenditure forming group 'B' items. The rest 184 items (69.96%) consumed only 8.26% (2,003,355.33 Birr) of total budget, classified as group 'C' items.

Provision of care in tertiary care hospitals is sensitive to the timely availability of facilities, including drugs. In case of drugs, besides the criticality factor, the cost factor must also be taken into consideration, as can be seen from our study, where (9.60, 14.89, 17.06, 19.45 & 12.17 %) of the pharmaceuticals consumed about (81.20, 79.00, 75.00, 79.23 & 76.15 %) of ADE of the pharmacy in TASH from 2009 to 2013 respectively (Table 1). These are items requiring greater monitoring as it has fewer drugs consuming most of the budget expenditure.

The study result (Figure 1) showed that all five years pharmaceuticals ABC analysis was compatible under the V. Pareto curve. From this figure in 2009 class A pharmaceuticals took the maximum of budget percentage range (70-80%) than other years. But on 2011 class A items took lower portion of budget range and maximum of items proportion (10-20%). There was some similarity on the availability of class A, B & C items on 2010, 2012 and 2013.

VEN analysis

For VEN classification in current study, Tikur Anbessa Specialized Hospital drug list VEN classification which was published in 2012 was used. From TASH drug list, most of pharmaceuticals were Vital. There was no almost non-essential item in pharmaceutical VEN analysis (Figure 2). .

As shown in figure 2, the VEN classification for 2009 revealed that out of 250 pharmaceuticals stored, 168 items(67.2%) were considered 'Vital'; 55 items (22%) were 'Essential', 1 item (0.4%) were considered 'Nonessential and the rest 26 items (10.4%) were out of hospital drug list . In 2010 out of 282 pharmaceuticals stored, 179 items (59.7%) were considered 'Vital'; 54 items (20.5%) were 'Essential' and 2 item (0.5 %) were considered 'Nonessential'. In 2011 out of 299 pharmaceuticals stored, 220 items(73.5%) were considered 'Vital'; 61 items (20.4%) were 'Essential', and there is no 'Nonessential items , but two drugs; Nitrofurazone 0.2 %, 30gm ointment and white petrolatum ointment 1kg both of them were class C which were out of hospital drug list.

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In 2012 and 2013 in similar way there was no any nonessential item and out of 293 pharmaceuticals stored in 2012, 176 items (60%) were considered 'Vital'; 44 items (15%) were 'Essential' but chlorpheniramine maleate + betamethasone combined drug(class C) were out of hospital drug list. In 2013 out of 263 items stored 184 items (70%) were considered 'Vital'; 52 items (19.7%) were 'Essential. Respiridone 1 and 2 mg and Niclosamide 500 mg (class C) were found out of hospital drug list.

From the total utilized items, more than 230 same pharmaceuticals had been purchased every year. From these on 2011 there was some improvement by supplying newer items relative to the rest four years because in 2011, there were 37 newer items than 2009 and 2010. Majority of these newer items were laboratory pharmaceuticals. In 2013 there were some newer vital drugs added. From these; Dexamethasone 0.5mg tab, Ergometrine malate 0.25mg/ml, Etoposide 20mg/ml injection, Ifosfamide 1000mg inj, Imipramine 25mg tablet and Mesna 100mg/ml in 4ml injection are vital drugs and their sustainability had great impact on health service improvement.

ABC-VEN matrix analysis

Table 2 shows ABC-VEN matrix analysis of Pharmaceuticals from 2009 – 2013. Category I items which consumed 12481901.8, 11053651.6, 16073428.2, 18200820.7, 21807548.7 ETB, respectively were either vital or expensive drugs which needs the practice of the principle of management by exception. Category II which consumed 407346.58, 507010.31, 595578.04, 431649.2, 1060044.03 ETB, from 2009 - 2013 respectively consists of drugs that were essential. Category III only for 2009 and 2010 accounted for 2149.15, and 5317 ETB, the rest years have no any Category III item, consists of drugs that were nonessential and inexpensive which were the lowest in the hierarchy of priority. From top ten Class I pharmaceutical; Insulin /NPH/ 100u/ml in 10ml, Examination glove, Gauze Bandage, Surgical Gloves Sterile latex number 7.5 of 50 pairs, Vicryl (Polyglycoliq) different size and shape, and Normal Saline (Sodium chloride 0.9%) injection of 1000 ml existed through five years by covering huge amount of money. X-ray film of different size and Adriamycin 500 mg injection also existed in top ten Class I items for four subsequent years. The rest Vincristine sulphate 1mg, dextrose in water 1000 ml , catheter different size, ceftriaxone 1g injection, catgut different size, Merisilk different size and shape and surgical blade different size were also recorded in Class I in the five years at least once.

Discussion

The present study reports Tikur Anbessa Specialized Hospital (TASH) pharmaceuticals inventories from 2009-2013 by using ABC-VEN matrix analysis. The findings indicate that the majority of pharmaceuticals were either vital or expensive, and need a management with greatest attention (Table 2).

The principle of management by exception should be practiced by top management for such items to which would help in keeping a check on the annual budget and their availability. The consumption and its effect on the stock level should be monitored continuously, and the safety stock must be kept low to reduce carrying cost.

The pharmaceuticals shortage was a considerable issue for TASH. There were more than 20 main pharmaceuticals categories in TASH Drug/VEN list based on hospital's diagnosis and treatment units. But majority of pharmaceuticals were not delivered to each unit and these units only had an average of 20% of their need in 2013 as compared to the hospital drug list. Based on TASH drug list data 51.54%, 43.87% & 4.66% of pharmaceuticals under inclusion were V, E & N respectively.[17] Even though pharmaceuticals delivered in five years showed 59.7 to 73.5% items were Vital, availability of pharmaceuticals relative to the hospital drug list was very low.

Even though some pharmaceutical supplies were provided by donation, majority of drugs are still on hand of Budget pharmaceuticals supply management. There is huge gap on lifesaving drugs availability implementation. The purchasing system might always follow similar ways of procurement since there were no more new drugs seen relative to hospital's drug list.

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There could be serious functional dislocation of patient care when vital drugs are not available even for a short period. Therefore, these should always be stocked in sufficient quantity to ensure their constant availability. The shortage of essential drugs can be tolerated for a short period. If these essential drugs (like antibiotics, antineoplastic) are not available beyond a few days or a week, the functioning of the hospital can be adversely affected. These drugs should also be controlled and monitored carefully. The shortage of non-essential drugs would not adversely affect patient care or hospital functioning even if shortage is prolonged and there were no more non-essential items.

Similar studies also showed essential drug shortage and irregular accessibility is common in different region of Ethiopia. Research done by Jimma University on availability and affordability of essential drugs in public health center in south western Ethiopia showed the shortage on essential drugs availability which forced patients to purchase drugs from private pharmacies, go to informal sector or forgo treatment.[20] Study done in Gondar town, North West part of Ethiopia also showed; even though average availability of essential medicines in the public health centers in Gondar town was good, rural health centers were stock out for significant percent of essential medicines over the six months period.[21] Though TASH has diverse and super-specialized services availability than hospitals in Ethiopia where ABC-VEN studies were done including Dilla University Hospital [22], Debire Markos Hospital [23] , there were similarity on pharmaceuticals which had higher budget. This may be due to common supply by governmental pharmaceuticals supplier, pharmaceuticals fund supply agency (PFSA).

The hospital has to ensure the availability of various drugs round the clock as these are essential and vital for patient care. The Pharmacy Departments are often charged with responsibility for managing drug and delivery system costs.[24] For improvement of therapeutic outcome of hospital activity, availability of pharmaceuticals has a great role.[25] But in real situation, pharmaceutical supplies interruption is very common even in developed countries. A survey which had been done in USA on oncology medication availability indicates that oncology drug shortages occurred frequently in the first half of 2011.[26]

Lack of essential medicines is still one of the most serious public health problems. About 30% of the world's population lacks the medicines they need. The situation is worse in the poorest parts of Africa and Asia where the figure rises to over 50 % .[27] Study on Indian Armed Forces revealed that out of 1536 items in their drug list considered for the study, only 400 drugs of the total inventory consuming approximately 90.00% of the operating budget of the hospital towards expendable medical stores, the remaining 1136 (73.95%) drugs consuming only 10% of the total expenditure.[28]

Similar study carried out by Gupta et al (2007) in a tertiary care hospital in India showed that 14.4% items consumed 70% of annual drug expenditure comprising the A group while group C constituted 63.7% items which consumed 10% of annual drug expenditure of the hospital. Another study done in Thailand also showed that from 336 medicines, 26 items (7.74%) consumed 70.84% of annual value and classified into class A, 37 items (11.01%) consumed 19.23% of annual value classified into class B, and 273 items (81.25%) of annual value consumed only 9.93% forming class C.[15]

Since ABC categorization follows V. Pareto way of classifying the percentage of class A, B and C items, results done in different hospitals may show related percentage of items. But magnitude of total budget show difference since there may be different representative pharmaceuticals and budget in each health setting. This study also showed that the total number of items analyzed annually in TASH was lower than Kenya. For example MSH Pharmaceuticals consumption report on the Aga Khan University Hospital of Kenya , the drug therapeutic committee did an ABC analysis of 793 medicines for 2005 and found that the top four products were antimicrobials that accounts 10% of total budget [11] This may implies TASH being a university hospital which mobilize lower number of pharmaceuticals.

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Some pharmaceuticals which were Vital in TASH may be essential in other Hospitals. So it may be difficult to make an association based on number of vital, essential and desirable items. In Debre Markos Referral Hospital VEN study in Ethiopia, the pharmaceuticals were classified as 67.4 % vital, 28.9% essential and 5.02% non-essential.[23] VEN analysis study done in Goa Medical College Hospital of India showed that, around 12.36% of the drugs were classified as vital, 47.12 % as essential, and the remaining 40.50% as desirable.[18] Sassoon Indian General Hospital also showed 148 (50.9%), 117(40.2%) and 26 (8.9%) items were found to be V, E and D category items, respectively.[29] Relative to other related study findings, Tikur Anbessa Specialized Hospital VEN result contained more Vital items and lower non-essentials. Generally the drugs belonging to category A requires strict managerial control, accurate data driven forecasting of demand, close check on budgetary control, minimum safety stock, frequent stock taking and judicious purchasing, stocking, issue and inspection policy. Category B drugs require moderate control by middle level managers whereas category C requires minimum control measures for order and purchase and such functions can be delegated to lower level managers.

Conclusion

The study finding indicated that there are huge pharmaceuticals in TASH which need proper management and supervision. Even if budget utilization shows increment from 2009 to 2013, there was an asymmetric trend on pharmaceutical availability. Relative to TASH drug list there is a gap on pharmaceuticals availability. Majority of pharmaceuticals were found vital items. From these; Category I pharmaceuticals took higher proportion than Category II & III and most of Category I pharmaceuticals were also Class A and V items that need great attention of top management for annual budget allocation and their availability.

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Table 1: Pharmaceuticals ABC analysis result of Tikur Anbessa Specialized Hospital (2009-2013)

Year	Quantity	Class	% of total budget consumed or ADE	% of total Items
2009	24	A	81.20	9.60
	51	B	13.30	20.40
	175	C	5.50	70.00
2010	42	A	79.00	14.89
	59	B	15.20	21.00
	181	C	5.70	64.20
2011	51	A	75.00	17.06
	47	B	15.00	15.77
	201	C	10.00	67.23
2012	57	A	79.23	19.45
	60	B	9.80	20.48
	176	C	5.50	60.00
2013	32	A	76.15	12.17

	47	B	15.63	17.87
	184	C	8.26	69.96

ADE = Annual Drug Expenditure

Table 2 :AC-VEN matrix analysis of pharmaceuticals at Tikur Anbesa Specialized Hospital (2009-2013)

	ABC	**A**			**B**			**C**			**Total**		
	VEN	ADE	%ADE	Qun	ADE	%ADE	Qun	ADE	%ADE	Qun	ADE	%Qun	Qun
2009	V	10084722.7	75.66	18	1547085.8	11.61	43	434640.3	3.26	107	12066448.85	67.2	168
	E	415452.9	3.12	3	276967.18	2.08	7	130379.4	0.98	45	822799.48	22.0	55
	N/D	0	0.00	0	0	0.00	0	2149.15	0.02	1	2149.15	0.4	1
	NA	328379.4	2.46	3	28800	0.22	1	80920.47	0.61	22	438099.87	10.4	26
	Total	10828555	81.24	24	1852853	13.90	51	648089.32	4.86	175	13329497.35	89.6	250
2010	V	8854734.69	70.36	36	1331814.2	10.72	44	446108.3	6.91	99	10632657.19	63.5	179
	E	420994.36	3.31	5	378156.61	2.49	13	128853.7	2.18	36	928004.67	19.1	54
	N/D	0	0.00	0	0	0.00	0	5317	0.04	2	5317	0.7	2
	NA	63036	0.97	1	74647	1.18	2	116409.5	1.84	44	254092.5	16.7	47
	Total	9338765.05	74.64	67	1784588.01	28.97	54	696689.3	10.97	273	11820042.36	100.0	282
2011	V	10936873	64.44	44	2123057	12.51	40	1306804	7.70	137	14366734	73.58	220
	E	1706694.18	10.06	6	301510.34	1.78	5	294067.7	1.73	51	2302272.22	20.74	62
	N/D	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0
	NA	112963.5	0.67	1	106640	0.63	2	83607.6	0.49	14	303211.1	5.69	17
	Total	12756530.7	75.16	51	2531207.3	14.91	47	1684479.3	9.92	202	16972217.32	100.00	299
2012	V	15288678	72.93	44	1384079	6.60	37	776457	3.70	95	17449214	60.07	176
	E	751606.7	3.59	5	266695.8	1.27	8	164953.4	0.79	30	1183255.9	14.68	43
	N/D	0	0.00	0	0	0.00		0	0.00	0	0	0.00	0
	NA	1502404	7.17	9	532908	2.54	15	295322.8	1.41	50	2330634.8	25.26	74
	Total	17542688.7	83.68	58	2183682.8	10.42	60	1236733.2	5.90	175	20963104.7	100.00	293
2013	V	16719063	68.95	28	2954400	12.18	35	1471120	6.07	120	21144583	69.58	183
	E	662965.74	2.73	3	703983.63	2.90	10	356060.4	1.47	39	1723009.77	19.77	52
	N/D	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0
	NA	1084300	4.47	1	120840	0.50	2	176175.4	0.73	25	1381315.4	10.65	28
	Total	18466328.7	76.15	32	3779223.6	15.59	47	2003355.8	8.26	184	24248908.17	100.0	263

ADE=Annual Drug Expenditure in Ethiopian birr, % refers to percentage of ADE, Qun = quantity of item per year , %Qun = percentage of items , NA = items that were not available in VEN classification

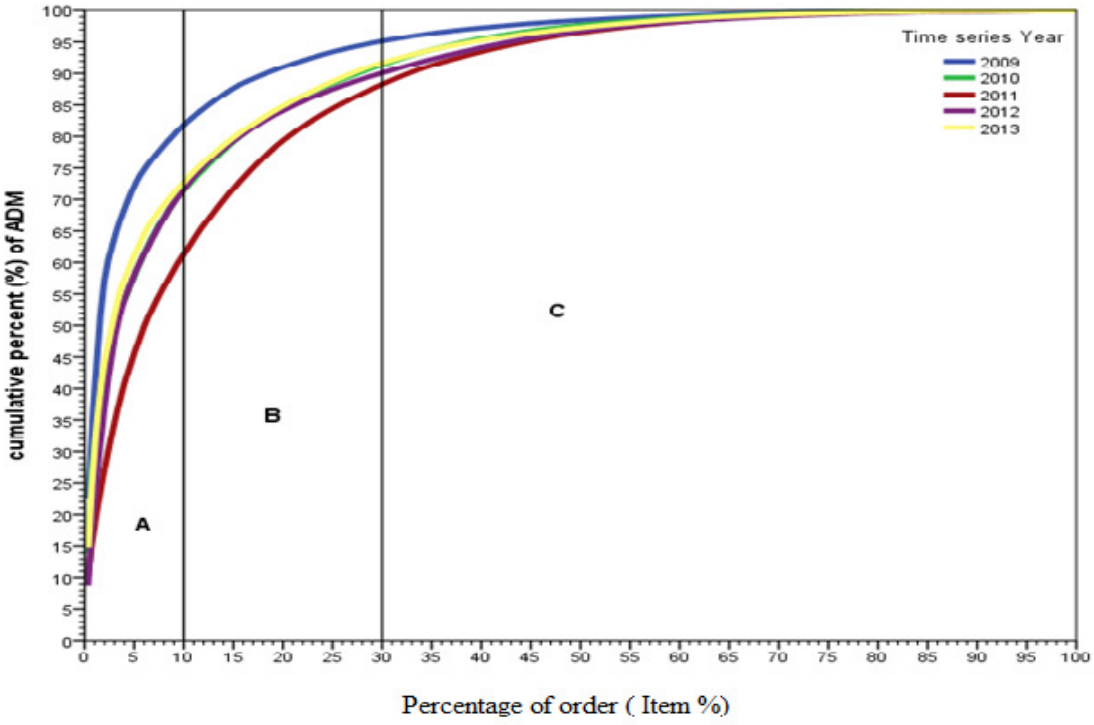

Figure 1:Tikur Anbessa specialized hospital pharmaceuticals ABC cumulative curve (2009-2013)

ADE = Annual Drug Expenditure in Ethiopian Birr

References

1. Organization for Economic Cooperation and Development .Health at a Glance: OECD Indicators, OECD Publishing. 2013. Available at: http://dx.doi.org/10.1787/health_glance-2013-en, Accessed on: 10/10/2014.
2. Abula T, Ashagrie G. Assessment of drug utilization from prescribers and dispensers perspectives in selected towns of Amhara region, Ethiopia.*Ethiop. J. Health Dev.* 2003; 3:231-237.
3. Management Sciences for Health. Managing Drug Supply: The Selection, Procurement, Distribution, and Use of Pharmaceuticals 2nded, Kumarian Press Books on International Development, USA. 1997
4. Anand T, IngleG, KishoreJ, Kumar R. ABC-VED Analysis of a Drug Store in the Department of Community Medicine of a Delhi Medical College. *Indian J Pharm Sci.* 2013;75(1): 113–117.
5. Devnani M, Gupta AK,Nigah R. ABC and VED analysis of the pharmacy store of a tertiary care teaching, research and referral healthcare institute of India. *J Young Pharmacists.* 2010 ;2: 201-205.
6. Thawani V, Turankar A, Sontakke S, Pimpalkhute S, Dakhale G, Jaiswal K,Gharpure K. Economic analysis of drug expenditure in government Medical College hospital, Nagpur. *Indian J pharmacy.2004;* 36 (1) : 15-19.
7. Kassie G, Mammo M. Assessment of pharmaceuticals store management in woreda heath offices of west Harergea zone, Ethiopia. *Int.Res. J.pharm.2014;*5(8):642-645.
8. Dhoka D, Choudary L. ABC Classification for Inventory Optimization. IOSR Journal of Business and Management (IOSR-JBM). 2013;15(1): 38-41.
9. Nigah R , Devnani M ,Gupta A. ABC and VED Analysis of The Pharmacy Store of a Tertiary Care Teaching, Research and Referral Healthcare Institute of India. *Young Pharmacists.2000;* 2(2):113-212
10. Gupta R, Jain B, Garg R.ABC and VED Analysis in Medical Stores Inventory Control. *MJAFI.2007*; 63(4):326.
11. Management Science for Health. Managing Access to Medicines and Health Technologies. 2012. Available at:*apps.who.int/medicinedocs/documents/s19617en/s19617en.pdf.*Accessed on: 24/12/2014
12. Monton C, Charoencha L, Suksaeree J. Purchasing and inventory management by pharmacist of a private hospital in Northeast of Thailand. *International Journal of Pharmacy and Pharmaceutical Sciences. 2014;* 6(5): 401-405.
13. Kant S, Pandaw C, Nath L. Scientific inventory planning in materials management. Hosp Mater Manage. *J AcadHospAdm.1989;* 14:16-9.
14. Dwivedi S, kumar A, Kothiyal P. Inventory Management: A Tool of Identifying Items That Need Greater Attention for Control. *The Pharma Innovation.2012;* 1(7):125-127.
15. Junita I, Sari R. ABC-VED Analysis and Economic Order Interval (EOI)-Multiple Items for Medicines Inventory Control in Hospital. Maranatha Christian University, Bandung, Indonesia. 2012.Available at: www.caal-inteduorg.com/ibsm2012/.../041SME-ViralMP Comparative. Accessed on 30/06/2014.
16. Abate SM. Assessment of Pharmaceuticals Inventory Management Systems for the Years (2008,2009,2010) Using ABC-VEN Matrix Analysis at Addis Ababa University College of Health Sciences Tikur Anbessa Specialized Hospital. AdvPharmacoepidemiol Drug Saf. 2013 ; 2:137.
17. List of Pharmaceuticals for Tikur Anbessa Specialized Hospital 1st Edition. By: Drug and Therapeutics Committee of Tikur Anbessa Specialized Hospital in collaboration with PFSA and USAID/SIAPS, Addis Ababa, Ethiopia. 2012.
18. Vaz F, Ferreira A, Kulkarni M, Motghare D. A Study of Drug Expenditure at a Tertiary Care Hospital: An ABC-VED Analysis. Pereira-Antao Journal of Health Management.2008; 10(1):119-127.

19. Sarbjeet K, Neelam C, Vinod K, Singh G. Inventory control techniques in medical stores of a tertiary care neuropsychiatry hospital in Delhi.2013; 5(1): 8-13.
20. Abiye Z, Tesfaye A, Hawaze S. Barriers to access: availability and affordability of essential drugs in a retail outlet of a public health center in south western Ethiopia. Journal of Applied Pharmaceutical Science. 2013 ;3 (10), 101-105.
21. Fentie M, FentaA ,Moges F *et al*. Ethiopia Hospital Reformation Implementation Guideline (EHRIG) Volume 1 (2010). Availability of Essential Medicines and Inventory Management Practice in Primary Public. *Journal of Pharma SciTech.2013;*4:2.
22. BezualemW, Tewodros E, Rediat B, Ayalew A. ABC-VEN analysis of Pharmaceuticals in Della University Hospital , Ethiopia. Della University Hospital.2012
23. Auditable Pharmaceutical Transactions and Services (APTS). A Guide for Implementation , Amhara National Regional State Health Bureau , Ethiopia. 2012 Available at: www.msh.org/.../auditable-pharmaceutical-transactions-and-services-apts. Accessed on: 13/05/2014.
24. Hussen A, Alemu M, Mohammednur M, Raya G, Hailu S. Pharmacy Practice In View Of Health Professionals InJimma University Specialized Hospital. *IJPSR.2012;* 3(2): 576-582.
25. Ferretti M, Favalli F, Zangrandi A. Impact of a logistic improvement in an hospital pharmacy: effects on the economics of a healthcare organization. *International Journal of Engineering, Science and Technology .2014;* 6 (3): 85-95.
26. McBride A, Holle L, Westendorf C, et al. National survey on the effect of oncology drug shortages on cancer care. *Am J Health-Syst Pharm.2013*;70 (7):609-617.
27. WHO, Equitable access to essential medicines: a framework for collective action, in WHO Policy Perspectives on Medicines ,2004.
28. Kumar S, Chakravarty A. ABC-VED analysis of expendable medical stores at a tertiary care hospital. Medical Journal Armed Forces, India. *Medical Journal Armed Forces India, 2015; 71 (1): 24-27.*
29. Poorwa W, Pandit P, Zite A. ABC and VED analysis of the drug store of a tertiary care teaching hospital. Indian Journal of Basic and Applied Medical Research. 2013; 3 (1):126-131.