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ABC-VEN Analysis of Medicine Expenditure at Mwananyamala Regional Hospital in Tanzania

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Abstract

Policymakers in developing countries are looking for effective and efficient ways to control hiking expenditure on medicines. This article shows the effectiveness of the ABC-VEN method to improve efficiency in resource use with data from Mwananyamala hospital in Tanzania. We used expenditure data for 233 medicines worth 909.9 million Tsh (392,386.4 USD) bought in the year 2018/2019. Data were extracted from the electronic system, receipts, and other relevant documents. Medicines were categorized according to their contribution to the total medicine expenditure (ABC) and their importance to the functioning of the hospital (VEN). 39 (17%) medicines belong to group A and 134 (57%) to C, which accounted for 70% and 10% of the total medicine expenditure, respectively. 15%, 78%, and 7% of the medicines belong to the Vital, Essential, and Non-essential groups, respectively. 65 medicines (28%) that accounted for 73% of the total medicine expenditure were in group I that requires stringent control. 4 high-cost non-essential medicines and 20 low-cost vital medicines accounted for 7% and 1% of the total medicine expenditure, respectively. Efficiency can be improved through rational prescribing and substituting high-cost non-essential with low-cost vital medicines.

Keywords

Tanzanian, Medicines, Expenditure, ABC Analysis, VEN Analysis, Hospitals

1. Introduction

Lack of access to essential medicines is a major public health challenge in devel-

oping countries. However, rising health expenditure and poor economic growth have made the situation worse. A recent WHO report showed that in most countries, total health expenditure is growing faster than the economy, but the growth is more rapid in low- and middle-income countries (LMIC) than in high-income countries i.e., 6% versus 4% (Xu et al., 2018). The proportion of total health expenditure spent on medicines in developing countries ranges from 7.7% to 67.6% (WHO, 2011). Thus, policymakers and healthcare workers in LMIC seek to implement sustainable, effective, and efficient approaches to contain the hiking cost of healthcare.

Irrational use and poor inventory control of pharmaceuticals can contribute to health system inefficiencies and wastage of scarce health resources, thus increasing total health expenditure. Controlling expenditure on medicines has received much interest from hospital managers, policymakers, and researchers in recent years. If rational use of medicines, effective and efficient medicine management practices are implemented within the existing limited health budget, it can reduce wastage of resources to ensure that more patients can be served (Devnani et al., 2010). Therefore, as the health sector faces a scarcity of resources, hospital managers must create an efficient inventory system that constantly monitors and evaluates the hospital's expenditure. With such a system, it is possible to identify and closely monitor the utilization of high-cost low volume and high-volume low-cost medicines to bring about the desired positive clinical and economic impact (Devnani et al., 2010; Pirankar et al., 2014).

The structure and organization of medicine supply chain systems vary between countries. In Tanzania, the Medical Store Department (MSD), which is a semi-autonomous public agency, procures, stores, and distributes medicines and other health commodities to all public health facilities. It has its headquarters in Dar es Salaam region but has 8 zonal offices in the country. MSD uses the pull distribution system where health facilities place orders quarterly through the request and report form (Ministry of Health, 2019). The Ministry of Finance allocates funds quarterly to health facility's accounts located at MSD via the Ministry of Health. Funds are then released from the facility accounts and transferred to the MSD working capital each time a health facility makes an order (Ministry of Health, 2019). When medicines are not available at MSD, health facilities can use funds collected from other sources including complementary funds generated from user fees, health insurance schemes, and other legal sources to purchase medicines from other sources (Mikkelsen-Lopez et al., 2014; Wiedenmayer et al., 2019).

Several researchers have highlighted inefficiency in the allocation of resources to medicine and poor inventory management in Tanzanian hospitals (Kagashe & Massawe, 2012; Lyombe, 2013). A National Drug Trafficking Study that was conducted in 2007 also identified similar challenges across different levels of the medicine supply chain system in the country (Euro Health Group, 2007). ABC-VEN is one of the most used strategies to evaluate medicine expenditure in

hospital settings to identify areas of resource allocation inefficiency. ABC analysis identifies and ranks medicines with a significant impact on overall inventory cost. The 10% most expensive medicines that consume about 70% of the expenditure are grouped as A while the least expensive 70% medicines grouped in category C consume 10% of the expenditure (Mahatme et al., 2012). VEN analysis, on the other hand, classifies medicines as either Vital, Essential, or Non-desirable based on how critical the individual medicine is needed for providing health services (Management Science for Health, MSH, 2012). A combination of ABC and VEN can bring a more meaningful control over the inventory of medicines (Devnani et al., 2010).

Our literature review identified only one study in Tanzania that was conducted at Muhimbili National Hospital using the ABC-VEN analysis. The study showed that even though there were a few class A medicines that consumed a considerable budget, there was no special inventory management and monitoring mechanism to ensure their rational prescribing and use (Lyombe, 2013). Therefore, the application of ABC-VEN analysis remains limited in Tanzania despite being one of the proven strategies for optimizing the use of scarce health resources on medicines and considering the existing challenges in medicine availability in hospitals. Therefore, this study aims to evaluate medicine expenditure at Mwananyamala hospital using the ABC-VEN method to identify areas to improve efficiency in resource use.

2. Methodology

2.1. Design and Setting

This is a hospital-based cross-sectional study. The study was conducted at Mwananyamala regional referral hospital located in Kinondoni Municipality in Dar es salaam, Tanzania. This hospital was purposively selected among the three regional hospitals because it served a much larger population. Kinondoni district is highly populated amongst the other five districts, with about half of the city population living in it (1.7 million people). The hospital has 254 beds and serves 1654 outpatient per day, including methadone clinics with over 1500 - 1800 patients per day. The hospital provides specialty outpatient services such as dental, psychiatry, ophthalmology, pharmacy, gynecology, HIV/AIDS care and treatment, methadone, and pediatrics, as well as inpatient care for pediatrics, surgery, ophthalmology, and gynecology. The hospital also provides antenatal care, postnatal care, and immunization service.

2.2. Sample Size

All the 233 medicines that were purchased by the hospital during the financial year 2018/2019 were included in the analysis. We excluded medicines for the vertical programs such as antiretrovirals, anti-tuberculosis, and family planning that are procured by donors. We also excluded donated or borrowed medicines from other health facilities.

2.3. Sources of Data

The data sources included were electronic databases, invoices, 6 ledgers identified as V6B and V7B for tablets and capsules, VE1 and VE2 for injectable and VC, and VD for other items, as well as other relevant records that could provide information about medicines purchased.

2.4. Data Collection and Analysis

We developed a simple tool that could be used to extract and record the information about the medicine name, date of the invoice, invoice number, unit of measure, unit price, and the number and quantities of each medicine purchased. These data were collected and fed into the MS Excel spreadsheet (Microsoft Excel®, Microsoft Corporation) for quantitative analysis. Medicines expenditure data was extracted in local currency i.e., Tanzanian shilling (Tsh), and thereafter converted to USD at a rate of 1 USD = 2318 Tsh.

Information about the unit price and the quantities of each medicine purchased were extracted from the purchase invoices and the ledgers. The total expenditure for each medicine was calculated by multiplying the unit price and the total quantity, before estimating the percentage that each medicine contributed to the overall expenditure. Medicines were then ranked in descending order based on the percentage contribution to the overall expenditure. Finally, the cumulative percentage contribution was calculated, where the 70% cut-off point formed group A, and the remaining 20% and 10% formed group B and C, respectively (Devnani et al., 2010).

The same ABC list of medicine was subjected to VEN analysis by sorting them according to their importance to the functioning of the hospital. The VEN status of the individual drug was determined after a discussion with the team of health professions at the hospital, which comprised of the senior pharmacists, and a senior physician. They were guided by a list of the top ten diseases, the Standard Treatment Guideline, and the hospital formulary to decide whether the individual medicine belongs to V, E, or N groups. Each medicine was categorized as Vital, Essential, or Non-essential based on the following criteria:

1) The V category included medicines that are supposed to be in stock in the hospital at all times. These medicines are critically required for the survival of the patients and are crucial to providing essential health services.

2) E category medicines were those that satisfy the health care needs of most of the population, intended to be always in stock and adequate amounts. They are medicines that are effective against less severe but significant forms of illness but are not vital for providing primary health care.

3) Non-essential medicines are those of the least need, the shortage of which would not be detrimental to the patient's health. They are used for minor or self-limited illnesses.

The nine subgroups obtained from the ABC-VEN matrix were categorized further into three categories (I, II, III). Category I included AV, AE, AN, BV,

and BE groups which required high management priority. Category II with lower management priority constituted items belonging to BN, CV, CE, and the remaining CN group belonged to category III. The first and second alphabet in the category denoted its place in the ABC and VEN classifications, respectively.

2.5. Ethical Clearance

Ethical approval with reference no. MUHAS-REC-04-2020-220 was granted by the Directorate of Research and Publication Ethical Review Committee at MUHAS. The letter of permission and ethical clearance were sent to the district managers and hospital administration.

3. Results

3.1. ABC and VEN Classification

Table 1 shows that a total of 233 medicines were purchased for 909.9 million Tsh (392,386.4 USD) at Mwananyamala hospital during the financial year 2017-2018. Group A, included 39 medicines (17%) and accounted for 637 million Tshs (274,692.7 USD), representing 70% of the total medicine expenditure. The top five medicines in this group include Losartan + hydrochlorothiazide tablet, pregabalin 75 mg tablet, intravenous sodium lactate compound, lidocaine + dextrose injection, and vitamin B6, B12, and folic acid tablets. Nevertheless, group C included 134 medicines (57%) and accounted for 86.9 million Tsh, (37,470.9 USD) which represents 10% of the total expenditure.

Table 1 also shows that 35 medicines (15%) worth 70,884.5 USD i.e., 18% of the total medicine expenditure were in category V, 182 medicines (78%), which accounted for 72% of total medicine expenditure (282,553.05 USD) in category E and category N consisted of 16 medicines (7%) which accounted for 10% (38,948.84 USD) of the total medicine expenditure. Medicines found in group N that consumed large expenditures include vitamins B6, B12+ Folic acid, a combination of Calcium, vitamin D3, and vitamin A, sildenafil, cough syrups, ketoconazole shampoo, and suxamethonium and pancuronium injection, and others. Furthermore, our results demonstrated that vitamins and minerals alone

Table 1. ABC and VEN classification.

Categories	Number of medicines	Annual expenditure (USD)
A	39 (17%)	274,708.5 (70%)
B	60 (26%)	80,222.43 (20%)
C	134 (57%)	37,455.48 (10%)
Total	233	392,386.41
V	35 (15%)	70,884.52 (18%)
E	182 (78%)	282,553.05 (72%)
N	16 (7%)	38,948.84 (10%)
Total	233	392,386.41

accounted for 81% (31,382.76 USD) of the total expenditure and 10 medicines (63%) of the total medicines in the N category.

3.2. ABC-VEN Matrix

Medicines were further assigned to AV, AE, AN, BV, BE, BN, CV, CE, and CN subgroups using ABC-VEN reconciliation analysis, as shown in Table 2. Category AV consists of the nine most expensive vital medicines, which accounted for about 15% of the total expenditure (58,431.49 USD). The top five medicines in this group were sodium lactate and sodium chloride injection (intravenous fluids), soluble and Lente insulin injection (anti-diabetic), and rabies vaccine. Group AN consists of four expensive but non-essential medicines and accounted for 7% of the total expenditure (28,417.97 USD) which were varieties of vitamins and minerals and sildenafil 50 mg tablets.

Group CV represents vital medicines, but which did not consume a large chunk of the expenditure. There were 20 medicines in group CV and consumed 1% of the expenditure equivalent to 4096.67 USD. Examples of medicines from this group included betamethasone injection, aminophylline injection, phenobarbital sodium injection, and atropine injection. Likewise, group CN represents the 6 least costly and non-essential medicines, which consumed 1% of the expenditure (2630.5 USD) which were varieties of vitamins and minerals, suxamethonium injection, pancuronium injection, and magnesium trisilicate tablets.

3.3. ABC-VEN Categorization

Table 3 shows that category I had the largest expenditure of 287,156.69 USD

Table 2. ABC-VEN matrix.

Category	Number of medicine (%)	Annual expenditure in USD (%)
AV	9 (4%)	58,436.33 (15%)
AE	26 (11%)	187,856.44 (48%)
AN	4 (2%)	28,415.73 (7%)
BV	6 (2%)	8343.33 (2%)
BE	48 (21%)	63,996.76 (16%)
BN	6 (2%)	7882.34 (2%)
CV	20 (9%)	4104.87 (1%)
CE	108 (47%)	30,699.85 (8%)
CN	6 (2%)	2650.76 (1%)
Total	233	392,386.41

AV—High cost and vital, AE—high cost and essential, AN—High cost and non-essential, BV—medium cost and vital, BE—medium cost and essential, BN—medium cost and non-essential, CV—low cost and vital, CE—low cost and essential, CN—low cost and non-essential.

Table 3. Categorization of ABC-VEN matrix.

Category	Number of medicines (%)	Annual expenditure (USD) (%)
I (AV, AE, AN, BV, BE)	65 (28%)	287,156.69 (73%)
II (BN, CV, CE)	162 (70%)	102,578.95 (26%)
III (CN)	6 (2%)	2650.76 (1%)
Total	233	392,386.41

(73%). This group contains cost-driving medicines which require stringent control in terms of rational prescribing and economic analysis. Nonetheless, category II had 162 medicines worthy 26% of the annual medicine expenditure (102,578.95 USD) could potentially be a substitute for medicine in category I with the same therapeutic activity. Examples of medicines in this category were esomeprazole capsules, clotrimazole cream, cetirizine tablets, and adrenaline injection.

4. Discussion

This study has shown the usefulness of ABC-VEN analysis in categorizing medicines based on their contribution to the total expenditure and their importance in the functioning of a regional hospital in Tanzania. The most important finding is that 39 out of 233 medicines procured at Mwananyamala hospital for the financial year 2018/2019 accounted for 70% of the total medicine expenditure, and 4 out of these 39 high-cost medicines, which accounted for 7% of the total medicines' expenditure were not essential. Overall, the proportion of medicines belonging to each ABC, VEN, and ABC-VEN matrix classification was comparable to related studies that have been conducted in Kenya, Ethiopia, India, and Turkey (**Table 4**). The variation in the proportion of medicines in the ABC-VEN seen between the studies could be due to different demands for healthcare, the difference in disease patterns, the time when the studies were carried, price and regulations, and the overall organization of the healthcare system. However, for the I-III categorization, the difference could be due to the composition of those groups. For example, in this study group III had the CN medicines only.

Furthermore, our study shows that if ABC analysis was done alone, it would significantly control 39 (17%) of the items in category A, which consumed 70% of the hospital's annual medicine expenditure. On the contrary, B and C categories contained 7 and 18 of the lifesaving medicines, respectively, which belong to the Vital category, therefore, these categories are not to be ignored. This underscores the importance of combining the ABC and VEN analysis.

In this study, 5 of the 39 medicines in group A accounted for a quarter of total expenditure. The combination of losartan and hydrochlorothiazide (50 + 12.5 mg) for hypertension was the top high-cost medicine with an expenditure of 7%. This is not surprising since the prevalence of hypertension in Tanzania ranges from 19% - 35% in rural and urban areas, respectively. People aged 70 years and above have the highest prevalence of 70% (Mosha et al., 2017). The high burden

Table 4. Comparison with related studies.

Authors, year	Country	ABC (%)			VEN (%)			Categories (%)		
		A	B	C	V	E	N	I	II	III
Present study	Tanzania	17	25	58	15	78	7	28	70	2
Taddele et al., 2019	Ethiopia	15	22	62	31	67	1	40	59	1
GünerGören & Dağdeviren, 2017	Turkey	10	23	67	24	14	62	30	25	45
Devnani et al., 2010	India	14	22	64	12	59	29	22	55	23
Pirankar et al., 2014	India	13	17	70	7	45	48	18	49	33
Kivoto et al., 2018	Kenya	14	17	69	22	53	25	32	48	20
Anand et al., 2013	India	19	24	57	13	39	48	29	41	30
Jobira et al., 2021	Ethiopia	12	11	77	17	68	15	27	49	24
Gizaw et al., 2021	Ethiopia	15	20	65	42	49	9	48	45	7

of hypertension can increase mortality and morbidity from preventable complications such as renal failure, myocardial infarction, and stroke (Addo et al., 2007), which may explain the observed high expenditure on losartan and hydrochlorothiazide.

Vitamin and minerals accounted for 8% of total expenditure and were classified in the non-essential category, which consisted of 16 medicines. Even though vitamins and minerals are found in the diet, these supplements are useful to patients with deficiency (Kisamo et al., 2020; Osarenmwinda & Erah, 2015). However, in developing countries, literature shows that vitamins and minerals are overprescribed, which could increase the likelihood of adverse drug events, drug interactions, and increased healthcare costs (Morris-Paxton & Truter, 2020; Osarenmwinda & Erah, 2015). Therefore, the budget for vitamins and minerals could be redirected to other lifesaving medicines or given low priority.

In this study, we found that Proton Pump Inhibitors (PPI) including pantoprazole 40 mg tablet (CE), pantoprazole 40 mg injection (BE), esomeprazole 40 mg tablets (CE), rabeprazole 20 mg capsule (BE), rabeprazole 20 mg injection (AV), omeprazole 20 mg capsule (BE), lansoprazole 30 mg tablet (AE) accounted for 3% of the total medicine expenditure. While peptic ulcer is one of the significant public health problems with the seroprevalence ranging from 19% to 92% in Africa, and 65% to 79% among dyspeptic patients in Tanzania (Jaka et al., 2016), one wonders why all of these different types were purchased. Having so many brands of PPIs may contribute to unnecessarily added health costs, drug interactions, and adverse drug reactions following long-term use (Gupta et al., 2019; Lenoir et al., 2019).

Sildenafil, which is for erectile dysfunction and pulmonary arterial hypotension (PAH)was categorized as non-essential in the VEN classification but was in group A of high-cost medicines and accounted for 1% of the total expenditure in ABC classification. The prevalence of pulmonary hypertension in Africa is 9.8%, which is in the range of 10% - 20% reported in the US (Bigna et al., 2017) while

erectile dysfunctionis 24% - 29.7% in Tanzania (Nyalile et al., 2020; Pallangyo et al., 2016). Management of persistent pulmonary hypertension in neonates with sildenafil is considered cost-effective in resource-limited settings with few ventilators. Although in some countries due to its unfavorable clinical outcome, its use is either an off-label medicine or discouraged in the management of erectile dysfunction (Bermejo et al., 2018). We were not able to establish the use of sildenafil in this hospital but given it was placed in non-essential we believe it is used to manage erectile dysfunction. It is debatable whether lots of resources should be used to manage erectile dysfunction as opposed to other high-priority diseases.

ABC-VEN categorization revealed that category I had few high-cost medicines which accounted for 73% of total medicine expenditure. These medicines need stringent control by the top hospital management, including the hospital pharmacist to ensure their rational use, and need to be selected for inclusion in the hospital formulary through an evidence-based process. Evidence from Tanzania shows that irrational use of medicine is rampant in most health care facilities, which contributes to the wastage of scarce health resources. Antibiotics are excessively prescribed and used even in the situation when there is no indication such as in non-bacterial infections (Mambile et al., 2016). For example, ceftriaxone injection, which was in category I and consumed 2% of the annual medicine expenditure is commonly used irrationally in Tanzania, contributing to the emergency of resistant strains (Horumpende et al., 2020; Sasi et al., 2019; Seni et al., 2020; Sonda et al., 2019). Hospitals need to ensure these high-cost medicines are controlled to ensure their rational use to reduce wastage of resources.

Consistent application of economic evaluation to inform formulary decisions also needs to be considered at the hospital level in Tanzania. For example, although losartan + hydrochlorothiazide was the top cost driver at Mwananyamala regional hospital, we could not find its cost-effective evidence in Tanzania or Africa. This is not surprising since the formulary decision in Tanzania is rarely informed with economic evaluation evidence. Reasons for lack of use often cited in the literature include lack of capacity, which causes inconsistent use (Mori & Robberstad, 2012), and scarcity of such evidence in Tanzania (Mori & Robberstad, 2012; Robberstad & Hemed, 2010). Nevertheless, evidence from the literature shows that irbesartan+ hydrochlorothiazide is more cost-effective than losartan + hydrochlorothiazide in the management of hypertension due to fewer side effects, less persistence in therapy, and slower progression of diabetic neuropathy in type two diabetic patients (Ekman et al., 2008; Maniadakis et al., 2011). Therefore, high-cost medicines such as losartan + hydrochlorothiazide need to undergo rigorous evaluation before being added to the formulary because of their huge budgetary implication.

4.1. Policy Implication

The mismatch between health resources and the burden of disease in Tanzania and other developing countries is large. Hence policymakers, hospital managers, and pharmacists need to ensure the limited financial resource are used efficiently

to stock medicines with the greatest potential to maximize health benefits to society. The ABC-VEN method is a simple approach that needs to be adopted and applied routinely in hospitals to optimize the use of resources and bring about increased access to essential medicines.

4.2. Strengths and Limitations

To the best of our knowledge, this is the first study to use ABC-VEN analysis at a regional hospital in Tanzania. Apart from its key findings the study also demonstrates that ABC-VEN is an easy to apply and effective strategy that can also be used in Tanzanian settings. At least we found three limitations. First, the study was conducted in one health facility hence limiting the generalizability of its findings to other health facilities with different organizational structures, medicine selection processes, and inventory management systems. Second, other pharmaceutical supplies worth 482,130,500 Tsh were not studied, which could have shown more areas of inefficiency to improve resource use at the hospital. Third, the hospital runs both the manual and electronic data system, sometimes with discrepancies between them casting doubt on the accuracy of the data. Counterchecking of medicine in the invoice, ledger, and electronic system was done to try to minimize the existing errors and improve data quality.

5. Conclusion

This study was able to categorize medicine expenditure at Mwananyamala hospital based on the ABC-VEN method. The study found areas that represent an inefficient use of scarce health resources. The hospital can increase efficiency through stringent prescribing control of high-cost medicines and substituting high-cost non-essential with low-cost vital medicines. If this method is used routinely at the hospital level in Tanzania, it could enhance the efficiency of the medicine inventory management system by optimizing the use of limited resources. This will bring a significant advantage as it will ultimately bring a substantial saving in the overall hospital budget by either removing it from the hospital list or close monitoring for the rational use of non-essential medicine without affecting patient care. This will eventually enhance the availability, accessibility, and affordability of medicine in the community.

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Authors' Contribution

ATM conceived the study idea and developed the study design and contributed

to the analysis and wrote the first draft of the manuscript. PM collected the data, conducted the analysis, and wrote the first draft of the manuscript. ATM and GK supervised data collection. SH and RH contributed to the literature review. ATM, GK, RH, and SH reviewed the drafts of the manuscript. All authors contributed to the final manuscript and approved the submitted version.

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Conflicts of Interest

The authors declare that they have no conflicts of interest to disclose.

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