

A Study on Medicines Consumption Pattern of CHAG Providers in Ghana

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ABSTRACT

Background: A well-functioning pharmaceutical supply system is an important aspect of ensuring efficient and proper clinical services in any health care system. This analysis was conducted on 31-member health facilities of the Christian Health Association Ghana (CHAG) to determine current consumption patterns and related expenditure for medicines on the Ghana Essential Medicines List. The overall aim was to inform the setting up of a digital pharmaceutical supply chain management system for CHAG providers.

Methodology: Our Always Better Control (ABC) analysis involved a one-year retrospective cross-sectional review of drug consumption and related expenditure data to help identify medicines that required focused attention. Drugs were divided in three categories: Category A (80% of total annual consumption), Category B (15%) and Category C (5%). Anatomical therapeutic chemical codes were then used to categorize the top twenty (category A) essential drugs to find out the highest consuming therapeutic categories.

Results: The total value of essential medicines consumed in 2016 by the studies CHAG hospitals was GHC 29,327,267 (US\$6,665,288) and the clinics was GHC 2,923,561 (US\$664,445). From the ABC analysis, 23.9% of medicines consumed 79.4% of total drug budget for hospitals and 31.5% consumed 79.5% of the drugs budget for clinics representing category A. The therapeutic category of the top twenty medicines showed a pattern of high antibiotic use with commensurate high cost to facilities.

Conclusions: In the context of CHAG's planned digital supply chain, this study showed applying the ABC and TCA analysis provides a useful tool to narrow down the few essential medicines to achieve cost savings on expensive medicines.

Keywords: Medicines; Consumption patterns; Providers; Health facilities, Supply chain; Therapeutic category

INTRODUCTION

Medicines are an important aspect of health care to maintain, improve and restore people's health through the treatment and prevention of disease. Health facilities, therefore, seek to ensure that their pharmaceutical supply systems stock adequately required products to guarantee an uninterrupted supply of all essential items. Integrating supply management and maintaining medicines quality in distribution are aspects of a reliable health supply system that helps to secure increased

and sustained access to essential medicines. Medical systems are however characterized by complex processes, operational challenges and expensive treatment modalities in terms of the cost of medicines and consumables [1]. Maintaining an efficient functioning supply system requires significant funds for the regular purchasing of materials. With insufficient funding, efficient planning, design and organization of the medicines supply to ensure proper clinical and administrative services is even more essential [2]. The negative impact of stock-outs of essential medicines at health facilities on morbidity, mortality

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and disease epidemiology has been widely documented [3–5]. In sub-Saharan Africa, causes that have been identified include inadequate procurement financing and procedures, poor planning and distribution resources as well as limited skilled personnel and supply capacity [6–8]. Amid resource-constraint and with limited management time, efficient utilization of organizational resources is essential, and effective inventory management is needed for substantial efficiency gains in total annual hospital budgets [9,10]. In health care systems, it is beneficial to introduce effective logistics practices and supply chain systems to control cost as well as procurement and distribution which would also impact positively on the cost of healthcare to patients.

Inventory control is a system that helps institutions to determine what, when and how much to order as well as how much to stock so that purchasing costs and storing costs are kept as low as possible [2]. Effective and efficient organizations use inventory management as an important tool to develop and manage raw materials to guarantee the adequate supply and availability of drugs [11]. This helps to protect against the fluctuation in supply and demand, uncertainty and minimizes waiting time. A successful inventory management control also positively influences manpower savings and provides simplification and transparency of processes to ensure the smooth functioning of the facility. In particular, the hallmark of pharmaceutical inventory management is cost-containment and improved efficiency and studies have shown that management of inventory leads to cost savings as it helps reduce annual drug expenditure of hospitals [12]. According to Pandya and Thakkar, facilities can make savings on their total investment in inventories through appropriate inventory control [11]. Apart from financial savings, they also note that inventory control also leads to savings on space, manpower, transparency and smooth flow of operational processes. The techniques for inventory management are several, such as reducing inventory cost, better stock management and inventory storage [11]. They include HML (High, Medium, Low) Analysis, VED Analysis (Vital, Essential and Desirable), FSN Analysis (Fast, Slow and Non-Moving), SDE Analysis (Scars, Difficult and Easily available), GOLF Analysis (Government, Ordinary, Local and Foreign), SOS Analysis (Seasonal and Off- Seasonal) and ABC Analysis. This study employed the ABC analysis which provides a simple method for classifying items or events into three categories based on their relative importance that is according to the frequency of use and their value. Other studies have noted that the tool provides a means for identifying items that need greater control attention but also note its drawback as being based only on monetary value and rate of consumption of the items [13]. Some scholars have noted that ABC analysis can be valuable not only in facilitating procurement-related activities such as determining sources for lower-priced products but also in assuring that procurement is consistent with public health priorities as well as assessing how order frequency affects overall supply [14]. For example, ordering category A items more often and in smaller quantities should lead to a reduction in inventory holding costs. A study conducted an ABC analysis to explore its feasibility in effective management of a medical store focusing on total annual consumption of value of different items [15]. Results showed an effective control and reduction of about two-thirds of the total expenditure by just controlling only a quarter of the drugs.

The Med4All initiative and consumption patterns of medicines on the Ghana Essential Medicines list by CHAG institutions

The Christian Health Association of Ghana (CHAG) is the second-largest health service delivery agency of Ghana's Ministry of Health. It brings together faith-based network organizations owned by 25 Christian church denominations involved in the provision of health care and training of health professionals. At the time of the study, CHAG had a network membership of 302 health facilities and health training institutions. The health facility providers under CHAG provide care to about 35%-40% of all in-patient and outpatient care in Ghana although its infrastructure amounts to just above 5.5% of the national health infrastructure [16]. In partnership with the PharmAccess Group (PAG) which is an international non-governmental organization, dedicated to improving access to quality health care for people in sub-Saharan Africa, the two institutions are seeking to set up a digital pharmaceutical supply chain management system for medicines for CHAG providers called "Med4All" which is an acronym for "Medicines for all". The Med4All initiative is a digital medicine supply chain platform that connects medicines suppliers to healthcare providers and payers. Through the innovative digital supply chain platform, the project aims to make quality medicines accessible and affordable by addressing quality, affordability and availability constraints in the medicines supply chain system in Ghana with a focus on the problem of fake and substandard medicines which according to the World Health Organization, are estimated to be about 30% [17]. An estimated one in ten medical products in low- and middle-income countries is substandard or falsified World [18]. Counterfeits and substandard medicines are responsible for many unnecessary deaths among patients. A list of factors such as a fragmented and poorly regulated market with weak quality control, inefficiently managed procurement and inventory management and low liquidity of healthcare facilities combine to contribute to the booming fake medicines market. The platform seeks to tackle the listed supply chain challenges in an integrated way by:

1. Helping healthcare facilities efficiently manage their inventory and forecasting medicines demand.
2. Digitally pooling medicines for better negotiations with suppliers to achieve cost reductions through economies of scale that are then reinvested into provider facilities.
3. Promoting an innovative and transparent quality control mechanism that ensures that quality drugs are procured, transported to facilities and prescribed to patients.
4. Supporting facilities on the platform with access to credit so they can pay their suppliers on time and hence do not have to pay the high-interest rates of supplier credits.

Med4All is intended to support all 330 CHAG facilities which provide health care to the most vulnerable and underprivileged population groups in all regions of Ghana. For example, in 2016, CHAG facilities made up 7.4% of health infrastructure in Ghana and contributed 29% of national inpatient and 20% of national outpatient services. In June/July 2017 a baseline study was carried out to provide an understanding of the current medicines procurement practices and consumption pattern of CHAG providers for medicines in the Ghana

Essential Medicines List and National Formulary as well as the National Health Insurance Medicines List (NHIML). This paper presents findings on the study component that assessed current consumption patterns of CHAG institutions for medicines on the Ghana Essential Medicines List using the ABC analysis tool. The study outcome was meant to inform how to integrate the ABC Analyzer tool into a system that catalyses the use of digital payments (mobile money, transfer orders, electronic cards etc.) for medicines procurement by CHAG providers.

MATERIALS AND METHODS

The study was conducted on a sample of CHAG member health facilities and institutions across the country that were selected based on purposive and random sampling techniques. This took into consideration ecological and geographical location such as rural-urban factors, denominational representation and level of health facilities. Using an adaptation of the sampling procedure of WHO Methodology for Level II-Facility Surveys, five regions were selected out of the then ten in the country to apply all study tools. Two main criteria were considered in selecting the study regions and comprised: i) Socio-economic profile and agro-ecological zone and ii) The concentration of CHAG facilities in a region. Six CHAG health facilities in each region were selected, making a total of thirty facilities for the study. One facility was added in one region because of its unique status as a polyclinic that had just transitioned into a hospital and provided inpatient services as all hospitals do. Ethical clearance for the study was obtained from the Ministry of Health and CHAG headquarters. Local health managers were contacted for permission and cooperation. Oral consent was obtained from all respondents who reserved the right to opt-out at any time of the study.

ABC analysis

The principle of ABC analysis popularly known as Always Better Control and it is based on the Pareto principle for material management of separating the vital few from the trivial many [19]. The analysis classifies items into three categories, where the first 10% to 20% of items/drug consumes 70% to 80% of the budget, the next 10% to 20% consumes 15% to 20% of the budget and the third and last 60% to 80% of items consumes 5% to 10% of the budget. Table 1 below summarizes the observation. Such a categorization allows a supply manager to identify inventory hot spots, and separate them from the rest of the items, especially those that are numerous but not that profitable. Further, it helps identify items that may not be needed in stock at all times. The analysis uses MS excel or other appropriate software to run analysis that can be applied to purchased or consumed health commodities. The ABC analysis in this study involved a one-year retrospective cross-sectional review of drug consumption and related expenditure data in the facilities surveyed. The medicine consumption patterns of facilities in 2016 were surveyed individually or per facility. Quantitative analysis was performed using MS Excel. The expenditure of individual items was calculated by multiplying the total units of each drug consumption by the unit price. The annual expenditure of individual items was arranged in descending order. The percentage expenditure and cumulative drug expenditure percentage were then calculated. The list was then subdivided according to their annual usage into Category A, B and C items, based on the cumulative cost percentage

of 80%, 15% and 5%, respectively. The outcome variables were the number of drugs that belonged to each category and related percentages of annual expenditure. Essentially, Category A-items were items that constitute 10%-20% of the medicines but consume 80% of the budget/annual consumption value. Category B-items take up the next 10%-20% of the items but consume 15% of the budget/annual consumption value. Category C-items also accounted for 60-80% of inventory items but account for only 5% of total consumption value.

Table 1: ABC analysis.

Category	% of Budget	% of Drugs ordered	% of Budget in study
Category A drugs	70-80%	10-20%	80%
Category B drugs	15-20%	10-20%	15%
Category C drugs	5-10%	60-80%	5%

Therapeutic analysis

The World Health Organization defines essential medicines as those that satisfy the priority health care needs of the population. Essential medicines list is thus intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality, and at a price, the individual and the community can afford [20]. In this study, all the medicines surveyed were part of the essential medicines list in Ghana. The Anatomical Therapeutic Chemical (ATC) classification system is used to categorize the active ingredients of drugs according to the organ or system on which they act and their therapeutic, pharmacological and chemical properties. As part of conducting the ABC analysis in this survey, the ATC codes were used to categorize the top twenty (category A) only essential medicines in all surveyed facilities to find out the highest consuming therapeutic categories of facilities on drugs.

RESULTS AND DISCUSSION

Table 2 provides a summary of the ABC analysis for the 21 hospitals and 10 clinics in the survey. The 21 hospitals had a total of 938, 978 and 1995 drugs for categories A, B and C respectively. The ABC analysis revealed that in the hospitals, 24.3% (45), 25.1% (47) and 50.6 (95) items were found to be A, B and C category items respectively. They amounted to 79.9% (23,438,567.87 or US\$5,326,947.24), 15.0% (4,415,806.65 or US\$1,003,592.42) and 5.0% (1,472,893.43 or US\$334,748.51) of the average annual drug expenditure of the 21 hospitals in 2016. For the 10 clinics, Category A had a total of 253, category B had 228 and category C had 358 drugs. On ABC analysis, 30.6% (25), 27.2% (23) and 42.3% (36) items were found to be A, B and C category items respectively in the clinics. They amounted to 79.6% (GHS2,325,452.89 or US\$528,512.02), 15.2% (GHS449,426.90 or US\$102,142.48) and 5.1% (GHS148,681.65 or US\$33,791.28) of the average annual drug expenditure of the 10 clinics in 2016. The cut-offs for both hospitals and clinics differed marginally within acceptable margins. Figure 1 presents the ABC analysis cumulative curve which depicts the cumulative percentage of the total drugs compared with the cumulative percentage of medicine expenditure for hospitals and clinics in 2016. The curve shows the trend for the distinct categories of the ABC for the hospitals and clinics.

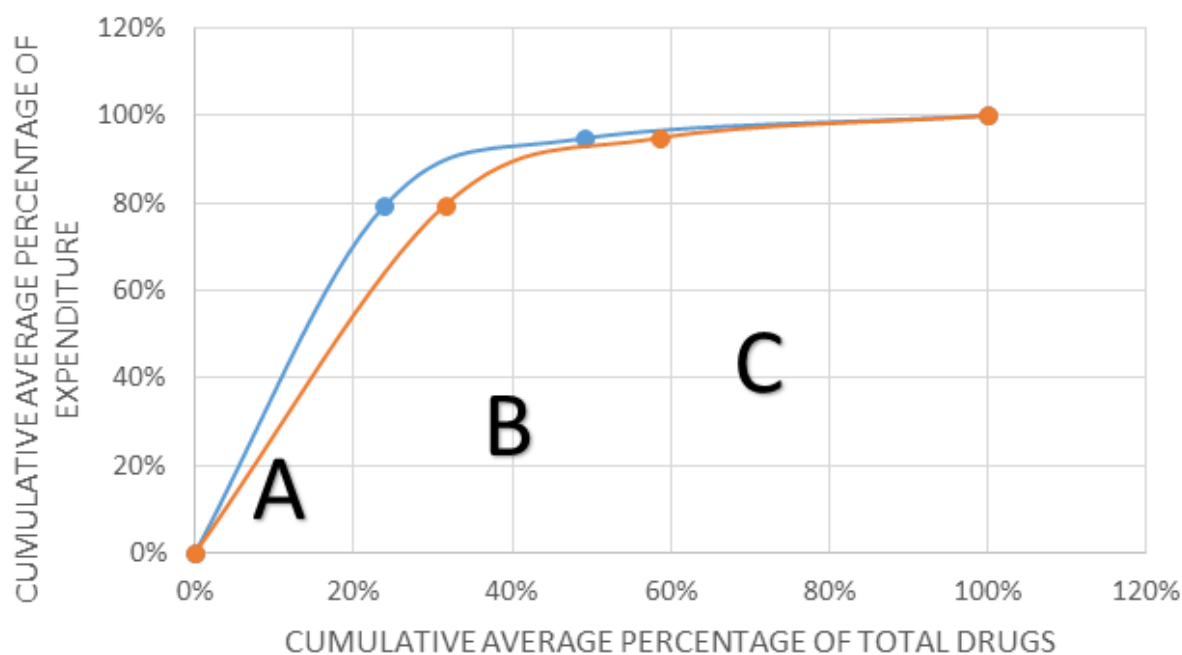


Figure 1: ABC analysis cumulative curve. Note: (—●—) Hospital; (—●—) Clinic.

Table 2: Summary of ABC analysis for 21 hospitals and 10 clinics.

Variables	ABC Category					
	Hospitals (n=21)			Clinics (n=10)		
	A	B	C	A	B	C
Total no. of items in inventory	938	978	1995	253	228	358
% of total annual consumption (mean)	79.9	15	5	79.6	15.2	5.1
% of items in inventory (mean)	24.3	25.1	50.6	30.6	27.2	42.3
Value of annual consumption (GHS)	2,34,38,567.87	44,15,806.65	14,72,893.43	23,25,452.89	4,49,426.90	1,48,681.65
Value of annual consumption (US\$)*	53,26,947.24	10,03,592.42	3,34,748.51	5,28,512.02	1,02,142.48	33,791.28
Number of Drugs (MEAN)	45	47	95	25	23	36
Mean Value of Annual Consumption (GHS)	11,16,122.28	2,10,276.50	70,137.78	2,32,545.30	44,942.69	14,868.17
Mean Value of Annual Consumption (US\$)*	2,53,664.15	47,790.11	15,940.40	52,851.20	10,214.25	3,379.13

Note: *Exchange rate of the cedi to US\$ in 2016 was 1US\$=GHS4.4.

Therapeutic Category Analysis (TCA)

The summary results for the therapeutic category analysis of the top twenty-category medicines for each of the facilities are aggregated and presented for hospitals and clinics respectively. Regarding the 21 hospitals, the results showed that in 2016, antibiotics were the commonest average annual essential medicine expenditure. Altogether, the mean count of antibiotics among the top twenty categories A drugs was as high as 7.7 for hospitals and amounted to a mean expenditure of GHS351,662.44 which translated to 25.2% of the entire

essential medicines (Category A to C) expenditure of hospitals in the study (Table 3). Apart from antibiotics, the next two high consumption essential medicines in the hospitals were antihypertensive and antimalarial constituting a mean count of 2.6 and 2.1 respectively. Antihypertensive medicines consumed an average of GHS146,545.46 and constituted a 10.5 per cent value of the total of all medicines while antimalarial medicines consumed an average of GHS82,998.47 constituting 5.9 percent value of the total of all essential medicines captured in the survey in the twenty-one hospitals.

Table 3: Mean count, Total value and percentage usage of Top 20 Category A medicines by therapeutic category in 21 Hospitals.

Medicines by therapeutic class ¹	Count	Mean count of medicines used	Mean value of medicines used in GHS	Mean value of medicines used in US\$	Total value of medicines used (in GHS)	% value of top 20 Cat A medicines	% value of total of all category A	% value of total of all medicines
Antibiotic	162	7.7	3,51,662.44	79,923.28	73,84,911.17	43.7	31.5	25.2
Antihypertensive	54	2.6	1,46,545.46	33,305.79	30,77,454.64	18.2	13.1	10.5
Antimalarial	44	2.1	82,998.47	18,863.29	17,42,967.95	10.3	7.4	5.9
Infusion	52	2.5	79,593.21	18,089.37	16,71,457.44	9.9	7.1	5.7
Analgesic/Antipyretic	31	1.5	30,931.92	7,029.98	6,49,570.31	3.8	2.8	2.2
Antidiabetic	17	0.8	26,060.50	5,922.84	5,47,270.59	3.2	2.3	1.9
Anesthetic	4	0.2	13,725.51	3,119.43	2,88,235.72	1.7	1.2	1
Proton pump inhibitor	7	0.3	10,942.31	2,486.89	2,29,788.51	1.4	1	0.8
Vitamin/Supplements	6	0.3	9,001.26	2,045.74	1,89,026.40	1.1	0.8	0.6
Haematinic	7	0.3	7,501.09	1,704.79	1,57,522.98	0.9	0.7	0.5
Smooth muscle relaxant	4	0.2	6,366.81	1,447.00	1,33,703.05	0.8	0.6	0.5
Laxative	1	0	5,337.50	1,213.07	1,12,087.50	0.7	0.5	0.4
Ophthalmic solution	6	0.3	5,210.05	1,184.10	1,09,411.00	0.6	0.5	0.4
Hormonal preparation	4	0.2	4,160.84	945.65	87,377.60	0.5	0.4	0.3
Antifungal	2	0.1	3,668.57	833.77	77,040.00	0.5	0.3	0.3
Antacid	2	0.1	3,615.85	821.78	75,932.88	0.4	0.3	0.3
Mucolytic	6	0.3	3,602.12	818.66	75,644.48	0.4	0.3	0.3
Anthelmintic	2	0.1	3,361.93	764.08	70,600.50	0.4	0.3	0.2
Topical preparation	1	0	2,266.67	515.15	47,600.00	0.3	0.2	0.2
Stimulant	2	0.1	2,258.29	513.25	47,424.00	0.3	0.2	0.2
Otic Preparation	1	0	2,125.71	483.12	44,640.00	0.3	0.2	0.2
Antiasthmatic	1	0	1,726.90	392.48	36,264.80	0.2	0.2	0.12
Antimotility	2	0.1	820.93	186.58	17,239.50	0.1	0.1	0.06
Opioid analgesic	1	0	473.57	107.63	9,945.00	0.1	0.04	0.03
Antitussive/Cough suppressant	1	0	118.11	26.84	2,480.40	0.01	0.01	0.01
TOTAL	420	20	8,04,076.02	1,82,744.55	1,68,85,596.44	100	72	57.58
							2,34,38,567.87	29327268

Note: ¹The list of medicines in the table are more than twenty (20) because the list is an aggregate of the top twenty category A medicines for each facility.

Data from the ten clinics provided in Table 4, also shows that the mean count of antibiotics was equally high and made up of 6.3 among the top twenty categories A drugs and amounted to an average of GHS 118,625.24 and equivalent to as high as 40.6% of the percent value of total of all the entire essential medicines (Category A to C) expenditure of clinics in the study (Table 4). The next high medicine expenditure items in the ten study clinics were Antimalarial which constituted a mean count of 3 and consumed an average of GHS 30,642.56 and comprised 10.5 percent of value of total of all essential medicines in the ten clinics. Analgesic/antipyretic was the third-highest expenditure item in the clinics and had a mean count of 2.3, consumed an average of GHS 196,004.27 and constituted 6.7% value of total of all medicines in the ten clinics covered in the study. The summary of the top twenty "Category A" medicines by therapeutic category by facility in all twenty-one hospitals and ten clinics is also annexed. The most striking finding in the distribution is that out of the twenty-one hospitals, antibiotics were the highest consumption item in eighteen of the facilities. Similarly, in the clinics, antibiotics were the highest consumption

item in seven out of the ten facilities. The availability of essential medicines at affordable prices is of primary importance in the provision of care in hospitals and clinics and for those matter health facilities in general. Inventory management which is the core of the pharmaceutical supply system seeks to make inventory decisions that minimize the total inventory cost and optimize quality by ensuring that scarce resources are used to meet the actual needs of consumers efficiently. This paper on analysis of the essential medicines consumption patterns of CHAG facilities using ABC analysis was carried out as part of a bigger study into procurement and consumption to inform the setting up of a digitally-supported medicines supply chain for CHAG institutions. Medicines management techniques like ABC are efficient and effective drug management tool that allows the inventory manager to prioritize medicines stock and reduce shortages. From the preceding findings, several issues are identified that lend themselves for consideration in relation to the efficient inventory management and cost reduction of medicines procurement objectives of the CHAG PAG Med4All medical supply chain entity.

Table 4: Mean Count, Total Value and percentage usage of Top 20 Category A by Therapeutic Category in 10 Clinics.

Medicines by therapeutic Class	Count	Mean count of medicines used	Mean value of medicines used in GHS	Mean value of medicines used in US\$	Total value of medicines used (in GHS)	% value of top 20 category A medicines	% value of total of All category A	% value of total of all medicines
Antibiotic	63	6.3	1,18,625.24	26,960.28	11,86,252.38	56.4	51	40.6
Antimalarial	30	3	30,642.56	6,964.22	3,06,425.63	14.6	13.2	10.5
Analgesic/Antipyretic	23	2.3	19,600.43	4,454.64	1,96,004.27	9.3	8.4	6.7
Infusion	20	2	12,537.60	2,849.45	1,25,375.99	6	5.4	4.3
Haematinic	5	0.5	5,243.17	1,191.63	52,431.70	2.5	2.3	1.8
Antihypertensive	9	0.9	4,858.23	1,104.14	48,582.27	2.3	2.1	1.7
Antitussive/Cough Suppressant	4	0.4	4,818.49	1,095.11	48,184.92	2.3	2.1	1.6
Anthelmintic	4	0.4	3,036.30	690.07	30,363.00	1.4	1.3	1
Smooth Muscle Relaxant	3	0.3	2,051.01	466.14	20,510.10	1	0.9	0.7
Antacid	2	0.2	1,942.30	441.43	19,423.00	0.9	0.8	0.7
Antihistamine	1	0.1	1,687.20	383.45	16,872.00	0.8	0.7	0.6
Antifungal	1	0.1	1,320.00	300	13,200.00	0.6	0.6	0.5
Ophthalmic Solution	1	0.1	1,250.00	284.09	12,500.00	0.6	0.5	0.4
Mucolytic	5	0.5	1,210.28	275.06	12,102.80	0.6	0.5	0.4
Vitamin/Supplements	4	0.4	1,053.88	239.52	10,538.80	0.5	0.5	0.4
Proton Pump Inhibitor	1	0.1	286.8	65.18	2,868.00	0.1	0.1	0.1
Antidiabetic	2	0.2	210.41	47.82	2,104.14	0.1	0.1	0.07
Nasal decongestant	1	0.1	118.8	27	1,188.00	0.1	0.1	0.04
Hormonal Preparation	1	0.1	15.2	3.45	152	0.01	0	0.01
TOTAL	180	18	2,10,507.90	47,842.70	21,05,078.99	100	90.5	72

The ABC analysis revealed the current (as it were) consumption patterns of a sample of CHAG institutions for medicines on the Ghana essential medicines list for the period under review. On average, 45 medicines out of 197 (24.3%) represented category A which contributes 80% of the total medicines expenditure consumed in 2016 in the 21 hospitals. Category B items comprised 47 items (25.1%) consuming 15% of ADE while Category C items which made up the majority of 95 (50.6%) in the hospitals consumed only 5% of medicines expenditure. This pattern was similar in the case of the clinics were on average 25 medicines out of 84 (30.6%) representing category A items constituted ~80%, Category B items comprised 23 items (27.2%) consuming ~15% of ADE while Category C items which made up the majority 36 (42.3%) consumed 5% of medicines expenditure in the clinics. In general, the study findings are consistent with Pareto's principle that a few drugs make up a substantial part of the drug expenditure of the two types of health facilities although they differ in the range indicated by Pareto. In terms of the consumption patterns, the findings are also similar to findings elsewhere that confirm the Pareto principle that a few drugs make up a substantial part of the drug expenditure. For example, a study conducted at the Kenyatta National Hospital in Kenya showed that out of 811 medicines, Category A medicines constituted 13.2-14.2% but consumed 80% of ADE, while Category B and C constituted approximately 16.5% and 70% respectively but consumed 15% and 5% respectively of ADE [21]. Another study also reported that in the Sudan National Health Insurance programme, 16.98% (n=80) of medicines making up Category A medicines accounted for 70.2% of ADE in 2016 while the Category C medicines that made up the highest proportion of 61.2% (n=288) accounted for just 9.9% of ADE [22]. A study from Ethiopia indicated that in 2009 Category A medicines made up of 24 medicines and constituting 9.60% consumed 81.2% of ADE; Category B comprised 20.4% and consumed 13.3 ADE while Category C items comprising 70.00% consumed only 5.50% of the total drug budget [23]. While most of the foregoing studies analyzed single facilities, our study is unique in the sense that it aggregated results from essentially district hospitals and clinics in the district and peripheral areas in the three ecological regions of Ghana.

One benefit of the ABC technique as applied in this study is that it assisted in identifying the medicines that have the heaviest economic impact on the operation of health facilities and therefore need attention in terms of supply chain management. The findings indicate that Category A medicines would need to have greater monitoring as it has fewer drugs consuming most of the money whereas medicines in Category B and C require moderate and less control respectively. That is to say to ensure that CHAG institutions can make optimum savings with its medicines budget with the reduction in the use of more cost-effective Category A medicines through closer checks on budgetary control, judicious purchasing, issuing and inspection, appropriate controls on stocking levels and accurate data-driven forecasting of demand. The benefit of this study, therefore, is that in the context of the planned Med4All, the ABC analysis provides a tool to narrow down the few medicines that require stringent managerial control. The Therapeutic Category Analysis (TCA) also showed that the proportion of antibiotics in the top twenty therapeutic categories contributes to the high value of annual consumption of the medicines, particularly

Category A medicines in both hospitals and clinics in the study. Aside from the cost implications, the high use of antibiotics may also have implications for consumer misuse and resistance. The data shows that wide sales, as well as the use of expensive products, partly account for the high expenditure items in the hospitals and clinics. There however needs for further studies that include morbidity patterns and medicines prescribed to fully understand the reasons.

Limitations

The ABC classification strategy is criticized as being very rough and the limiting values being randomly determined and offering only a figure of the current situation [24]. Another limitation of ABC analysis is that it is grounded only on monetary value and the rate of consumption of the item and does not consider if the medicine is lifesaving or not [25]. Again, the ABC analysis does not make itself amenable to analysis of comparing medicines of differing efficacy but it helped to illustrate those medicines that consume most of the budget. In this study, these included antibiotics, antihypertensives and antimalarials in the studied hospitals, and for clinics antibiotics, antimalarials and analgesic/antipyretic. To overcome the limitation of the ABC classification analysis, a future study of this nature could combine it with a VED (Vital, Essential and Desirable) analysis and also classify items based on vital, essential and desirable categories and combining it with the ABC classification to evolve a priority system based on the two (ABC and VED) to make decisions.

CONCLUSION

The ABC analysis can routinely be used to monitor consumption patterns and thereby control medicines utilization to ensure the optimal use of available resources in health care facilities. The analysis has revealed items that are highly used can be substituted with lower or more cost-effective alternatives. The usefulness of the information here is that the ABC and therapeutic category analysis can be used to ensure that facilities choose more cost-effective essential medicines in terms of competitive price and desired specification. This would enable facilities derive significant or high savings on their budget or expenditure on drugs if controls are exercised to check excessive purchases and/or orders, inappropriate prescribing and supply and also enforce judiciously an informed stocking and issuing of drugs. The medicines used in this analysis as listed are generics but there are varied price disparities between generics on the market. Therefore, selection should be based on good quality and more affordable brands. The expensive antibiotics use in hospitals surely needs further investigation, including morbidity patterns to better understand the situation. In terms of operational or policy recommendations to periodically inform the digital platform, CHAG facilities should conduct periodic ABC analysis to monitor their drug consumption and expenditure patterns to rationalize inappropriate medicines selection, procurement, stocking and use. It is important to acknowledge though that cost control is only one factor that can contribute to cost management, other factors such as quality and rationale contribute independently.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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AUTHORS CONTRIBUTIONS

Daniel Kojo Arhinful performed original draft, conceptualization, methodology, investigation, analysis, supervision and writing and review of the manuscript. Peter Yeboah and James Duah performed conceptualization, methodology and editing, Maxwell Akwasi Antwi and Alex Attache performed conceptualization, methodology, analysis and review of the manuscript. Michael Ntriri Preko and Irene Andoh performed methodology and analysis. George Afful and Angela Owusu Sekyere performed investigation, supervision and analysis. Tobias Rinke de Wit performed conceptualization, methodology, analysis, and review of the manuscript. All authors read and approved the manuscript.

REFERENCES

- Kumar S, Chakravarty A. ABC-VED analysis of expendable medical stores at a tertiary care hospital. *Med J Armed Forces India*. 2015;71(1):24-27.
- Anand T, Ingle GK, Kishore J, Kumar R. ABC-VED analysis of a drug store in the department of community medicine of a medical college in Delhi. *Indian J Pharm Sci*. 2013;75(1):113.
- Pasquet A, Messou E, Gabillard D, Minga A, Depoulosky A, Deuffic-Burban S, et al. Impact of drug stock-outs on death and retention to care among HIV-infected patients on combination antiretroviral therapy in Abidjan, Côte d'Ivoire. *PloS one*. 2010;5(10):e13414.
- Leung NH, Chen A, Yadav P, Gallien J. The impact of inventory management on stock-outs of essential drugs in Sub-Saharan Africa: secondary analysis of a field experiment in Zambia. *PloS one*. 2016;11(5):e0156026.
- Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet*. 2009;373(9659):240-249.
- Quick JD, Hogerzeil HV, Rankin JR, Dukes MN, Laing R, Garnett A, et al. Managing drug supply: the selection, procurement, distribution, and use of pharmaceuticals. West Hartford, Connecticut: Kumarian Press; 1997.
- Waako PJ, Odoi-Adome R, Obua C, Owino E, Tumwikirize W, Ogwal-Okeng J, et al. Existing capacity to manage pharmaceuticals and related commodities in East Africa: An assessment with specific reference to antiretroviral therapy. *Hum Resour Health*. 2009;7(1):1-5.
- Kangwana BB, Njogu J, Wasunna B, Kedenge SV, Memusi DN, Goodman CA, et al. Malaria drug shortages in Kenya: a major failure to provide access to effective treatment. *Am J Trop Med Hyg*. 2009;80(5):737.
- Pillans PI, Conry I, Gie BE. Drug cost containment at a large teaching hospital. *Pharmaco Economics*. 1992;1:377-382.
- Iannone R, Lambiase A, Miranda S, Riemma S, Sarno D. Modelling hospital materials management processes. *Int J Eng Bus Manag*. 2013;5:5-15.
- Pandya B, Thakkar H. A review on inventory management control techniques: ABC-XYZ analysis. *REST J Emerg Trends Model Manuf*. 2016;2(3):2016.
- Thawani VR, Turankar AV, Sontakke SD, Pimpalkhute SV, Dakhale GN, Jaiswal KS, et al. Economic analysis of drug expenditure in government medical college hospital, Nagpur. *Indian J Pharmacol*. 2004;36(1):15.
- Khurana S, Chhillar N, Gautam VK. Inventory control techniques in medical stores of a tertiary care neuropsychiatry hospital in Delhi. *Health*. 2013;5(01):8.
- Kastanioti C, Mavridoglou G, Karanikas H, Polyzos N. ABC analysis: A tool of effectively controlling pharmaceutical expenditure in Greek NHS hospitals. *J Pharm Health Serv Res*. 2016;7(3):173-179.
- Kant S, Pandaw CS, Nath LM. A management technique for effective management of medical store in hospitals. *Medical store management technique*. *J Acad Hosp Adm*. 1996;8(2-1):41-47.
- Yeboah P, Buckle G. The evolving partnership between the Government of Ghana and national faith-based health providers: leadership perspective and experiences from the Christian Health Association of Ghana. *Dev Pract*. 2017;27(5):766-774.
- Ali H, Amoyaw F, Baden D, Durand L, Bronson M, Kim A, et al. Ghana's HIV epidemic and PEPFAR's contribution towards epidemic control. *Ghana Med J*. 2019;53(1):59-62.
- Sambah F, Malau-Aduli BS, Seidu AA, Malau-Aduli AE, Emeto TI. Ghana's adherence to PASCAR's 10-point action plan towards hypertension control: A Scoping Review. *Int J Environ Res Public Health*. 2023;20(2):1425.
- Gupta RK, Gupta KK, Jain BR, Garg RK. ABC and VED analysis in medical stores inventory control. *Med J Armed Forces India*. 2007;63(4):325-327.
- Jumbam DT, Amoako E, Blankson PK, Xepoleas M, Said S, Nyavor E, et al. The state of surgery, obstetrics, trauma, and anaesthesia care in Ghana: A narrative review. *Glob Health Action*. 2022;15(1):2104301.
- Kivoto PM, Mulaku M, Ouma C, Ferrario A, Kurdi A, Godman B, et al. Clinical and financial implications of medicine consumption patterns at a leading referral hospital in Kenya to guide future planning of care. *Front pharmacol*. 2018;9:1348.
- Mousnad MA, Ibrahim MI, Palaian S, Shafie AA. Medicine expenditures in Sudan National Health Insurance Fund: An ABC-VEN analysis of 5-year medicine consumption. *J Pharm Health Serv Res*. 2016;7(3):165-171.
- Migbaru S, Yigeremu M, Woldegerima B, Shibeshi W. ABC-VEN matrix analysis of pharmaceutical inventory management in Tikur Anbessa Specialized Hospital for the years 2009 to 2013, Addis Ababa, Ethiopia. *Indian J Basic Appl Med Res*. 2016;5(2):734-43.

24. Saim AK. Mercury (Hg) use and pollution assessment of ASGM in Ghana: Challenges and strategies towards Hg reduction. *Environ Sci Pollut Res.* 2021;1-10.
25. Nigah R, Devnani M, Gupta AK. ABC and VED analysis of the pharmacy store of a tertiary care teaching, research and referral healthcare institute of India. *J Young Pharm.* 2010;2(2):201-205.