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Research Article

Tenders versus Consignment

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Objectives: This study aims to compare the impact of tenders and consignment on the purchase price of pharmaceuticals and the effect of consignment on liquidity. The study explores the feasibility of combining tenders and consignment to accrue the benefits of each.

Methods: A pre-post observational study design was used to retrospectively collect pharmaceutical purchase prices from the 2019 tenders, the 2020 consignment supplier invoices, and the 2022 tenders-for-consignment. Descriptive and inferential statistics were used to determine statistical significance. Cash flow statements from 2019 and 2020 were used to determine the change in liquidity. The mean purchase price was compared to the Management Sciences for Health International Medical Products Price Guide to determine the price ratio.

Results: The dataset included 65 products listed by proprietary name. Quantitative analysis of the purchase price obtained through tenders in 2019 and consignment in 2020 shows that the price increased by a median of 4.78% [IQR = -5.66% - 12.71%] (p=0.48). However, when tenders-for-consignment were introduced, the price was reduced by a median of -7.71% [IQR = -11.72% - 1.935%] (p=0.65). Consignment resulted in a direct cash savings of KES 4,427,266.10 in one year. The median price ratio was 4.4319 [IQR = 0.8496-12.6193].

Conclusion: Inventory consignment offers substantial savings through reduced capital expenditure. However, eliminating competition results in higher purchase prices that can harm the affordability of medicines. Comparatively, tenders provide the best prices because of competition between suppliers. Combining both results in substantial savings for the institution without negatively impacting the cost of medicines.

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Highlights

- The use of inventory consignment has been studied for high-value items in several industries, including healthcare. Primarily, consignment has been employed as a method of procurement to accrue financial savings as a result of reduced capital expenditure and reduced cost of borrowing. These benefits allow firms to increase their inventory without incurring additional costs, resulting in increased profitability. A well-documented consignment contract can reduce stockouts, improve fill rates, and benefit both the supplier and the customer equally.
- This research compares two procurement methods, i.e., tenders and inventory consignment, to purchase pharmaceuticals in a hospital set-up. The findings contribute to the existing literature by outlining the advantages and disadvantages of both methods. Additionally, this research further analyzes the impact of inventory consignment on the purchase price of pharmaceuticals. It also explores the possibility of combining tenders and consignment, as a hybrid model, to accrue the benefits of both.
- The findings from this research will enable administrators, procurement managers, and pharmacy managers to provide an innovative solution to manage scarce financial resources. Since pharmaceuticals represent a large percentage of the total expenditure, hospitals stand to benefit significantly if they are able to implement the consignment model. Furthermore, the hybrid model outlined in this research can be used to procure other items such as surgical and consumables, hospital linen, and orthopedic implants.

Introduction

Pharmaceuticals represent a large proportion of global health expenditure, ranging from 5% to 12% in developed countries to up to 40% in developing countries [1]. In most countries, irrespective of income level, governments provide limited funding for medicines [2], driving out-of-pocket spending. High medicine prices restrict access to medicine,

which has a detrimental effect on patients' health and the healthcare system [3].

Kenya is a Sub-Saharan African country with a population of 53.77 million and a gross domestic product (GDP) per capita of USD 2,006.8 (World Bank, 2021). Kenya is, therefore, classified as a low- and middle-income country (LMIC). The government of Kenya aims to achieve universal health coverage (UHC) by 2030 through the National Health Insurance Fund (NHIF). However, only 11% of the total population was enrolled in this scheme by 2014 [4]. To achieve UHC, access to medicines is essential [4].

Muhia et al. (2017) noted that to improve health management at an affordable rate, the procurement of pharmaceuticals and addressing the challenges faced play a critical role. Service organizations, such as hospitals, often purchase items of high value that may account for up to 80% of the total expenditure [5]. As such, it is paramount that the procurement process be conducted according to best practices to save costs, minimize waste, and streamline operations to gain a competitive advantage [5]. A well-structured procurement system will enable the acquisition of quality products in the correct quantity, at the right time, and at the right cost [1]. Smooth operations of hospital departments are, therefore, highly dependent on an efficient procurement system.

This research focuses on three procurement systems, i.e., a competitive tendering process, inventory consignment, and tenders-for-consignment, adopted in Bomu Hospital (BH), a private not-for-profit hospital located in Changamwe, a peri-urban suburb of Mombasa, Kenya. BH focuses mainly on serving the under-served members of society, and therefore, all paid services are highly subsidized. It is the mandate of the hospital's procurement and pharmacy department to ensure the hospital's inventory falls within the annual budget while ensuring the availability of all commodities to allow smooth operations of all departments.

A competitive tendering process is most likely to result in a procurement process free of bureaucracy, is transparent, and results in the acquisition of quality drugs at the cheapest market rate [1]. The competitive bidding, coupled with the prospect of bulk purchase, is expected to reduce drug costs by generating competition between pharmaceutical firms [6]. In 2014, BH adopted a competitive tendering process for the procurement of all commodities. The tendering process resulted in a reduction in the total inventory held by the hospital since a formulary governed the products. However, this still meant that a significant proportion of capital was set aside for the purchase of commodities.

Despite the many advantages, there is a downside to the tendering process. As seen in South Africa, tendering is dependent on an accurate consumption forecast, which may be difficult to achieve and may result in stock-outs and supply disruptions [6].

To further reduce the cost of inventory, BH adopted the consignment model in 2020 for pharmaceuticals. Consignment is "the process of a supplier placing goods at a customer location without receiving payment until after the goods are used or sold" [7]. Unlike traditional inventory sourcing, in consignment, the goods are owned by the vendor until used by the customer, and therefore, the customer does not incur any capital costs [8].

A consignment contract was signed between a willing supplier and the hospital prior to the supply of products on a first come-first serve basis. To ensure its success, the consignment contract was drawn to mutually benefit the hospital and the supplier. However, this process effectively eliminates the competition between suppliers, which can potentially drive up the purchase price of pharmaceuticals.

Towards the end of 2021, the hospital management decided to re-introduce tenders for pharmaceuticals in a two-step process. In the first step, suppliers were invited to procure the tender document only if they were willing to supply it on consignment. This is called a tenders-for-consignment or hybrid system, which effectively combines the advantages offered by the traditional competitive tendering process and inventory consignment. In the second step, products awarded on consignment were deleted from the drug formulary and were tendered for by suppliers who were willing to supply only through local purchase orders (LPO).

This study aims to compare the impact of tenders and consignment on the purchase price of pharmaceuticals and the effect of consignment on liquidity. The study explores the feasibility of combining tenders and consignment to accrue the benefits of each. The researcher also compares the mean adjusted cost price of pharmaceuticals with the Management Sciences for Health (MSH) International Medical Products Price Guide 2015.

Method

Study Setting

Bomu Hospital is a not-for-profit, non-governmental healthcare organization with a mission to provide safe, affordable, high-quality health and wellness services – with a special commitment to the underserved – delivered by dedicated professional teams operating from modern and accessible facilities. As such, all services are highly subsidized. Profitability is dependent on volume rather than markup, and all profits are ploughed back into the organization.

Study Design

This study used a pre-post observational design to assess the impact of consignment on the medicine procurement price and liquidity ratio.

Data Collection

The 2022 formulary was used as a backbone for data collection, as it has been built from the original document and includes products added annually. Generally, no products are deleted from the formulary unless withdrawn or discontinued from the market. The 2019 tender document was obtained from the hospital's finance department and edited to exclude all quotations except for the lowest quote for each product. All products, including those that did not have a bid (inserted as a zero value), were included for the initial data collection. The price data were inserted into the data collection tool. Next, the author signed a Non-Disclosure Agreement (NDA) with the hospital to access confidential supplier invoices to collect purchase price data for medicines under consignment. Lastly, the 2022 tender-for-consignment document was obtained from the finance department, and the price for each product was added to the data collection tool. All price data were converted to the unit price by dividing the price by the pack size. Data were collected in Microsoft Excel 2011 (version 2204), and all prices were listed in Kenya Shillings (KES).

For each molecule, the author determined whether it was listed in the Kenya Essential Medicines List 2019 [9]. Each molecule was classified based on the physiological system it acts on as per the British National Formulary 2012.

The second objective of this study is to determine the impact of inventory consignment on the liquidity ratio of the hospital. In analyzing the liquidity ratio, a direct comparison of cash flow statements from 2019 and 2020 was made. Liquidity was calculated using the formula:

Liquidity = current assets/current liabilities [10].

To compare the purchase price with the international reference price, the author obtained the mean international buyer unit price from the MSH International Medical Products Price Guide 2015 [11]. The buyer price was selected because it incorporates shipping costs, whereas supplier prices are Free on Board (FOB) and Ex Works (EXW) [11].

Data Management

Products for which purchase prices appeared in all three columns, i.e., 2019 tender price, 2020 consignment price, and 2022 tender-for-consignment price, were included for further analysis. All unit prices for 2019, 2020, and 2021 were adjusted for inflation upward to 2022. Inflation rates were obtained from the Central Bank of Kenya (CBK) website (https://www.centralbank.go.ke/). The following formula was used to calculate the inflation-adjusted price:

Inflation-Adjusted Price = (1 + a)n x base price

Where:
a = average annual inflation rate
n = number of years

The inflation-adjusted unit price in KES was converted to the United States Dollar (USD) for ease of comparison with the MSH International Medical Products Price Guide 2015. The exchange rate was obtained from the CBK website and was 1 USD = KES 113.57 (January 2022).

The mean international buyer unit price in USD was extracted from the MSH International Medical Products Guide 2015 and adjusted for inflation upward to 2022 using the annual inflation rates obtained from www.statista.com. The mean purchase price per unit was calculated for all drugs, and a mean purchase price to MSH international price ratio was calculated.

The 2019 current assets and current liabilities figures from the cash flow statements were adjusted for inflation to make them comparable to the 2020 figures. To further attribute cash savings to consignment, the author obtained the monetary value of the closing stock of pharmaceuticals in the central stores as of 31st December 2019 and compared it to the year during which consignment was implemented.

Data Analysis

Descriptive and inferential statistics were used to analyze the inflation-adjusted unit purchase prices listed in the three columns described above. A percentage price change was calculated for the difference in unit price seen between 2019 tenders and 2020 consignment, and between 2020 consignment and 2022 tenders-for-consignment. In all instances, the range, median percentage price change, and the interquartile range (IQR) were calculated. An independent t-test was conducted to examine the mean differences between prices for pharmaceuticals in an inventory consignment system and the mean prices for pharmaceuticals in a tender system, and the mean differences between prices for pharmaceuticals in a consignment system and the mean prices for pharmaceuticals in a hybrid system. An alpha value of 0.05 was used. The Levene's test was used to determine if the data were normally distributed. The author also calculated a net price change expressed as a percentage when the procurement system changed from tenders to consignment to tenders-for-consignment. The range, median, and interquartile range were calculated for the net price change. All descriptive statistics were done in Microsoft Excel 2011 (version 2204). Inferential statistics were conducted in SPSS version 25.

The mean unit purchase price to the MSH international price ratio was calculated and reported as a range, median, and IQR.

A simple mathematical formula was used to determine the percentage change in the liquidity ratio between 2019 and 2020.

Ethical Considerations

The research received an exemption from ethics review from the University of KwaZulu-Natal Biomedical Research Ethics Committee, reference number: 00015018.

Conflict of Interest

This research is part of the requirement for the corresponding author's Master's degree from the University of KwaZulu-Natal. SG and AA are employees of the hospital in which the research was conducted. VB acted as the supervisor to SG during the development of the dissertation.

Results

The 2022 formulary document consisted of 471 molecules listed by their chemical composition. Each chemical composition was further categorized into dosage form and strength, and for each dosage form and strength, a proprietary name was listed. A total of 754 products were listed by proprietary name in the 2022 formulary, which was used as the data collection tool. Comparatively, in 2019, the formulary consisted of 390 molecules corresponding to 577 products listed by proprietary name. A total of 81 molecules and 177 products listed by proprietary name have been added to the formulary between December 2019 and December 2021.

From the 2019 tender document, 64.6% (n=487) of the products had a quotation from the supplier. The remaining 267 products included those that did not have any bidder and products that were added in subsequent years, i.e., 2020 and 2021. In 2020, when consignment was introduced, 22.5% (n=170) of the products were supplied on consignment. The remaining 584 products were procured after seeking a minimum of three quotations from the market. However, these (n=584) were not included in further analysis. Lastly, towards the end of 2021, the hospital introduced tenders-for-consignment to take effect in 2022. In this tender, 465 products had a quotation, representing 61.7% of the total formulary. The remaining 289 products were tendered separately but not included in further analysis.

Visual inspection of the data highlighted 65 products that had a quotation in all three columns of the data collection tool, i.e., 2019 tender price, 2020 consignment price, and 2022 tender-for-consignment price, representing 8.6% of the total formulary. These 65 products were included for further analysis. The 65 products listed by proprietary name represented 54 molecules acting on different physiological systems. Analysis of these 65 products showed that 12.3% (n=8) act on systemic infections such as bacterial, amoebic, and fungal; 4.6% (n=3) are preparations used to treat vaginal and vulval fungal infections and urinary retention. Two of the three products represent the same formulation but different strengths of the same chemical composition. Furthermore, 23.1% (n=15) act on the gastrointestinal system and include products such as antacids and simethicone, antispasmodics, proton-pump inhibitors, and local preparations for anal and rectal disorders; 13.8% (n=9) act on the central nervous system and mostly belong to non-opioid analgesics; and 16.9% (n=11) act on the respiratory system, with most of the drugs being antihistamines and cough preparations. The remaining products (n=19) act on the ear, nose, and oropharynx (n=3), endocrine system (n=3), nutrition and blood (n=4), eye (n=2), and skin (n=7). Table 1 highlights the list of 65 products with their chemical composition, classification, formulation, strength, and proprietary name.

Chemical Composition	Classification	Formulation	Strength	Proprietary Name
Ciprofloxacin	Infections - Antibacterial	Tablets	500mg	Kuin
Levofloxacin	Infections - Antibacterial	Tablets	500mg	Glevonix
Cefixime	Infections - Antibacterial	Suspension	100mg/5ml (35ml)	Ceflorex
Cefuroxime	Infections - Antibacterial	Tablets	500mg	Altacef
Metronidazole	Infections - Antibacterial	Injectible	5mg/ml	Metronidazole
Itraconazole	Infections - Antifungal	Capsules	100mg	Fulcover
	Infections - Antifungal	Capsules	100mg	Canditral
Albendazole	Infections - Antihelmintics	Tablets	400mg	ABZ
Clotrimazole	Obstetrics, Gynaecology, and Urinary Tract Disorders - Preparations for vaginal and vulval candidiasis	Pessaries	200mg	Candid V3
	Obstetrics, Gynaecology, and Urinary Tract Disorders - Preparations for vaginal and vulval candidiasis	Pessaries	100mg	Candid V6
Tamsulosin	Obstetrics, Gynaecology, and Urinary Tract Disorders - Drugs for genito-urinary disorders	Tablets	0.4mg	Contiflo OD
Aluminium oxide/Mg Hydroxide/Simethicone	Gastrointestinal system - Dyspepsia and gastro-oesophageal reflux disease	Suspension	200ml	Flatameal-DS
Aluminium Hydroxide/Mg Hydroxide/ Simethicone	Gastrointestinal system - Dyspepsia and gastro-oesophageal reflux disease	Suspension	180ml	Relcer gel
Sodium Alginate/Sodium bicarbonate/Calcium carbonate	Gastrointestinal system - Dyspepsia and gastro-	Suspension	200ml	Gaviscon

Chemical Composition	Classification	Formulation	Strength	Proprietary Name
	oesophageal reflux disease			
Esomeprazole	Gastrointestinal system - Antisecretory drugs and mucosal protectants	Tablets	20mg	Esose
	Gastrointestinal system - Antisecretory drugs and mucosal protectants	Tablets	40mg	Esose
Omeprazole	Gastrointestinal system - Antisecretory drugs and mucosal protectants	Capsules	20mg	Omecer
Rabeprazole	Gastrointestinal system - Antisecretory drugs and mucosal protectants	Tablets	20mg	Razid
Rabeprazole/Mosapride	Gastrointestinal system - Antisecretory drugs and mucosal protectants	Tablets	20mg/15mg	Razid M
Dicyclomine/Paracetamol	Gastrointestinal system - Antispasmodics and other drugs altering gut motility	Syrup	10mg/40mg	Cyclopam
Hyoscine-N-butylbromide	Gastrointestinal system - Antispasmodics and other drugs altering gut motility	Injectible	40mg	Hysomide
Glycerine suppositories	Gastrointestinal system - Laxatives	Suppository	1g	Glycerin
	Gastrointestinal system - Laxatives	Suppository	2g	Glycerin
Hydrocortisone/Cinchocaine/Neomycin/Aesculin	Gastrointestinal system - Local preparations for anal and rectal disorders	Ointment	15gm	Anustat

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Chemical Composition	Classification	Formulation	Strength	Proprietary Name
Zinc Oxide/Bismuth Oxide/Bismuth sabgallate/Balsum Peru	Gastrointestinal system - Local preparations for anal and rectal disorders	Ointment	25gm	Anusol
	Gastrointestinal system - Local preparations for anal and rectal disorders	Suppository	10's	Anusol
Aceclofenac	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Tablets	200mg	Zyrtal OD
Aceclofenac/Paracetamol/Chlorzoxazone	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Tablets	100mg/500mg/500mg	Zyrtal MR
Aceclofenac/Serratiopeptidase	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Tablets	100mg/15mg	Zyrtal SP
Ibuprofen/Paracetamol	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Tablets	400mg/325mg	Brustan
	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Syrup	100mg/5ml	Brustan
Paracetamol	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Effervescent Tablets	500mg	Cipladon
	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Effervescent Tablets	1g	Cipladon
	Central Nervous system - Non-opioid analgesics and compound	Syrup	240mg/5ml	Panadol for children

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Chemical Composition	Classification	Formulation	Strength	Proprietary Name
	analgesic preparations			
	Central Nervous system - Non-opioid analgesics and compound analgesic preparations	Infusion	1g	Paracetamol
Paradichlorobenzene/Benzocaine/Chlorobutanol/Turpentine oil	Ear, nose and oropharynx - Drugs acting on the ear	Drops	10ml	Otorex
Choline Salicylate/Benzalkonium chloride/Lidocaine	Ear, nose and oropharynx - Drugs acting on the mouth	Gel	10g	Dentogel
Chlorhexidine/Metronidazole/Lidocaine	Ear, nose and oropharynx - Drugs acting on the mouth	Gel	15g	Quadrajel
Dydrogesterone	Endocrine system - Sex hormones	Tablets	10mg	Duphaston
Dexamethasone	Endocrine system - Corticosteroids	Injectible	4mg	Dexamethasone
Metformin/Glibenclamide	Endocrine system - Drugs used in diabetes	Tablets	500mg/5mg	Glucomet N
Vitamin B complex (Vit. B1, B6, B12)	Nutrition and blood - Vitamins	Tablets	200mg/50mg/1000mcg	Neuroforte
Ca Citrate, Vitamin D3, Mg, Zn	Nutrition and blood - Minerals	Tablets	1000mg/200IU/100mg/4mg	Bonium
Carbonyl iron, folic acid	Nutrition and blood - Anaemias and some other blood disorders	Tablets	100mg/500mcg	Saferon plus
Glucosamine/Chondroitin	Nutrition and blood - Minerals	Tablets	500mg/400mg	Freeflex
Adrenaline	Respiratory system - Antihistamines, hyposensitization, and allergic emergencies	Injectible	1mg/ml	Adrenaline
Cetrizine	Respiratory system - Antihistamines, hyposensitization, and allergic emergencies	Tablets	10mg	Cezine
	Respiratory system - Antihistamines, hyposensitization,	Syrup	1mg/ml	Cezine

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Chemical Composition	Classification	Formulation	Strength	Proprietary Name
	and allergic emergencies			
Levocetrizine	Respiratory system - Antihistamines, hyposensitization, and allergic emergencies	Tablets	5mg	Glencet
Levocetrizine/Montelukast	Respiratory system - Antihistamines, hyposensitization, and allergic emergencies	Tablets	5mg/10mg	Glemont L
Montelukast	Respiratory system - Antihistamines, hyposensitization, and allergic emergencies	Tablets	5mg	Montana
	Respiratory system - Antihistamines, hyposensitization, and allergic emergencies	Tablets	10mg	Montana
Salbutamol/Bromhexine/Guaifenesin/Menthol	Respiratory system - Cough preparations	Syrup	100ml	Ascoril
Terbutaline/Ambroxol/Guaifenesin/Sodium citrate/Levomenthol	Respiratory system - Cough preparations	Syrup	100ml	Aromel Plus
Terbutaline/Bromhexine/Guaifenesin/Menthol	Respiratory system - Cough preparations	Syrup	100ml	Brozedex
Dextromethorphan/Triprolidine/Pseudoephedrine/Menthol	Respiratory system - Cough preparations	Syrup	100ml	Ascoril D
Tetracycline	Eye - Anti-infective eye preparations	Ointment	0.01%	Ocucycline
Betamethasone/Neomycin	Eye - Anti-infective eye preparations	E/E drops	7.5ml	Probeta N
Mupirocin	Skin - Anti-infective skin preparations	Ointment	15g	Zupricin
Mupirocin/Betamethasone	Skin - Anti-infective skin preparations	Ointment	15g	Zupricin B
Clotrimazole	Skin - Antifungal preparations	Cream	15g	Candid

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Chemical Composition	Classification	Formulation	Strength	Proprietary Name
Ketoconazole/Zinc pyrithione	Skin - Antifungal preparations	Shampoo	200ml	Ketoplus
Lindane	Skin - Anti-infective skin preparations	Lotion	75ml	Liceoma
Clotrimazole/Beclomethasone diproprionate	Skin - Antifungal preparations	Cream	20g	Candid B
Miconazole/Beclomethasone/Neomycin	Skin - Antifungal preparations	Ointment	15g	Beclomin

Table 1. List of products selected for analysis. All products are listed by their chemical composition, classification, formulation type, strength, and proprietary name.

A price comparison between the tender system in 2019 and the consignment system in 2020 was done after converting the price in KES to USD and adjusting for inflation, and it showed that 44.6% (n=29) of the products resulted in a decrease in price when obtained through consignment. It was noted that 55.4% of the products showed a price increase when obtained through consignment. The percentage price change ranged from -35.85% to 96.16% [Median = 4.78%; IQR = -5.66% - 12.71%], with the highest price decrease seen in Ketoplus Shampoo® and the largest price increase seen in Adrenaline injections [Laborate, India] (Table 2). A similar analysis was done to compare the unit price obtained through consignment with the unit price obtained when tenders-for-consignment was adopted. This showed that 66.2% (n=43) of the products showed a decrease in price when tenders-for-consignment was used as a procurement method. Only 33.8% (n=22) of products showed a price increase. Compared to tenders versus consignment, the percentage price change ranged from -169.11% to 22.85% [Median= -7.71%; IQR = -11.72% - 1.935%] (Table 2).

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			Tender Price 2019	Consignment Price 2020	Hybrid System 2022			
Proprietary Name	**Formulation**	**Strength**	**Price in USD**	**Price in USD**	**Price in USD**	**Percentage Change in Price (Tenders versus Consignment)**	**Percentage Change in Price (Consignment versus Hybrid)**	**Net Percentage Change in Price**
Glycerin	Suppository	1g	0.1247	0.1926	0.0716	35.25	-169.11	-133.86
Glycerin	Suppository	2g	0.1424	0.2049	0.0872	30.52	-135.10	-104.59
Paracetamol	Infusion	1g	0.7796	1.1805	0.6164	33.96	-91.52	-57.56
Candid V3	Pessaries	200mg	0.9220	0.6820	0.6604	-35.18	-3.28	-38.46
Ocucycline	Ointment	0.01	0.2079	0.1967	0.1497	-5.66	-31.44	-37.10
Omecer	Capsules	20mg	0.1819	0.1462	0.1308	-24.46	-11.70	-36.16
Ketoplus	Shampoo	200ml	8.4403	6.2130	6.4348	-35.85	3.45	-32.40
Flatameal-DS	Suspension	200ml	2.1828	2.1642	1.7434	-0.86	-24.13	-25.00
Brozedex	Syrup	100ml	1.4032	1.7707	1.2767	20.75	-38.69	-17.94
Brustan	Syrup	100mg/5ml	2.2348	2.1150	1.8931	-5.66	-11.72	-17.39
Brustan	Tablets	400mg/325mg	0.0935	0.0885	0.0792	-5.66	-11.72	-17.39
Dexamethasone	Injectible	4mg	0.0728	0.1476	0.0881	50.69	-67.58	-16.89
Glencet	Tablets	5mg	0.3056	0.2889	0.2642	-5.78	-9.36	-15.15
Canditral	Capsules	100mg	0.7796	0.7378	0.6824	-5.66	-8.12	-13.78
Glevonix	Tablets	500mg	0.4989	0.3935	0.4579	-26.80	14.06	-12.74
Anustat	Ointment	15gm	2.4427	2.7052	2.2101	9.71	-22.40	-12.70
Beclomin	Ointment	15gm	1.1954	1.2690	1.0742	5.80	-18.13	-12.33
Candid	Cream	15gm	1.9230	1.8494	1.7170	-3.98	-7.71	-11.69
Candid V6	Pessaries	100mg	0.4470	0.4230	0.4033	-5.66	-4.89	-10.56
Metronidazole	Injectible	5mg/ml	0.2339	0.2754	0.2201	15.09	-25.13	-10.04
Zupricin	Ointment	15gm	3.6588	3.5906	3.3460	-1.90	-7.31	-9.21
Zupricin B	Ointment	15gm	4.5632	4.4759	4.2265	-1.95	-5.90	-7.85
Cipladon/Parafast	Effervescent Tablets	500mg	0.0915	0.1033	0.0881	11.44	-17.31	-5.86
Ascoril	Syrup	100ml	1.3929	1.3182	1.3208	-5.66	0.20	-5.47
Ascoril D	Syrup	100ml	2.2036	2.0855	2.0956	-5.66	0.48	-5.18
Dentogel	Gel	10g	1.2993	1.2297	1.2415	-5.66	0.96	-4.71
Contiflo OD	Tablets	0.4mg	0.6029	0.5706	0.5785	-5.66	1.37	-4.29
Ceflorex	Suspension	100mg/5ml (35ml)	4.2908	4.3284	4.1384	0.87	-4.59	-3.72
Aromel Plus	Syrup	100ml	2.0269	2.2035	1.9724	8.02	-11.72	-3.71
Glemont L	Tablets	5mg/10mg	0.4740	0.4483	0.4579	-5.73	2.09	-3.64
Liceoma	Lotion	75ml	1.6111	1.6920	1.5673	4.78	-7.96	-3.18
Fulcover	Capsules	100mg	0.7484	0.8185	0.7326	8.56	-11.72	-3.16

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			Tender Price 2019	Consignment Price 2020	Hybrid System 2022			
Proprietary Name	**Formulation**	**Strength**	**Price in USD**	**Price in USD**	**Price in USD**	**Percentage Change in Price (Tenders versus Consignment)**	**Percentage Change in Price (Consignment versus Hybrid)**	**Net Percentage Change in Price**
Zyrtal OD	Tablets	200mg	0.2027	0.2233	0.1999	9.23	-11.72	-2.49
Montana	Tablets	10mg	0.3160	0.3485	0.3120	9.33	-11.72	-2.38
Montana	Tablets	5mg	0.2786	0.3064	0.2755	9.07	-11.20	-2.13
Altacef	Tablets	500mg	0.5197	0.4919	0.5107	-5.66	3.69	-1.98
Zyrtal SP	Tablets	100mg/15mg	0.2079	0.2304	0.2063	9.79	-11.70	-1.91
Kuin	Tablets	500mg	0.1663	0.1859	0.1664	10.55	-11.72	-1.17
Glucomet N	Tablets	500mg/5mg	0.0665	0.0685	0.0660	2.90	-3.74	-0.84
Cyclopam	Syrup	10mg/40mg	1.1330	1.0723	1.1271	-5.66	4.86	-0.80
Zyrtal MR	Tablets	100mg/500mg/500mg	0.2443	0.2769	0.2479	11.79	-11.72	0.07
Razid M	Tablets	20mg/15mg	0.2858	0.3246	0.2906	11.95	-11.72	0.23
Razid	Tablets	20mg	0.1455	0.1653	0.1479	11.95	-11.72	0.23
Anusol	Ointment	25gm	4.9893	5.1154	5.0630	2.46	-1.03	1.43
Neuroforte	Tablets	200mg/50mg/1000mcg	0.1143	0.1077	0.1167	-6.15	7.67	1.53
Quadrajel	Gel	15g	1.9749	1.8691	2.0252	-5.66	7.71	2.04
Bonium	Tablets	1000mg/200IU/100mg/4mg	0.1175	0.1112	0.1233	-5.66	9.82	4.16
Cezine	Tablets	10mg	0.1195	0.1426	0.1277	16.20	-11.72	4.48
Cipladon/Parafast	Effervescent Tablets	1g	0.1819	0.2029	0.1937	10.35	-4.74	5.61
Panadol for children	Syrup	240mg/5ml	2.6090	2.9020	2.7824	10.10	-4.30	5.80
Esose	Tablets	20mg	0.1299	0.1230	0.1409	-5.66	12.72	7.05
Otorex	Drops	10ml	1.5800	1.4953	1.7170	-5.66	12.91	7.25
Cezine	Syrup	1mg/ml	1.0914	1.0821	1.1799	-0.86	8.29	7.43
Freeflex	Tablets	500mg/400mg	0.2308	0.2181	0.2527	-5.82	13.71	7.89
Relcer gel	Suspension	180ml	1.8190	1.7215	2.0252	-5.66	14.99	9.33
Adrenaline	Injectible	1mg/ml	0.0062	0.1623	0.0881	96.16	-84.34	11.82
Probeta N	E/E drops	7.5ml	0.7068	0.7870	0.8013	10.19	1.78	11.97
Hysomide	Injectible	40mg	0.0333	0.2951	0.1673	88.73	-76.40	12.33
Esose	Tablets	40mg	0.1632	0.2164	0.2201	24.59	1.69	26.28
Gaviscon	Suspension	200ml	4.0434	4.6727	5.4592	13.47	14.41	27.87
Duphaston	Tablets	10mg	0.3929	0.6886	0.6186	42.94	-11.32	31.62
Candid B	Cream	20g	1.4240	2.7446	2.4654	48.11	-11.32	36.79
Anusol	Suppositories	10's	0.4158	0.5115	0.6630	18.72	22.85	41.57
ABZ	Tablets	400mg	0.0759	0.1476	0.1514	48.58	2.57	51.15

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			Tender Price 2019	Consignment Price 2020	Hybrid System 2022			
Proprietary Name	**Formulation**	**Strength**	**Price in USD**	**Price in USD**	**Price in USD**	**Percentage Change in Price (Tenders versus Consignment)**	**Percentage Change in Price (Consignment versus Hybrid)**	**Net Percentage Change in Price**
Saferon plus	Tablets	100mg/500mcg	0.0582	0.1640	0.1541	64.50	-6.40	58.10

Table 2. Net percentage change in unit purchase price when the procurement system changed from tenders in 2019 to tenders-for-consignment (hybrid system) in 2022.

Levene's test for equality of variances showed no violations (p = 0.296). The results indicate that the purchase price of pharmaceuticals through the consignment system (M=0.76, SD=0.53) was higher than the purchase price through the tender system (M=0.69, SD=0.61) with t(128)=-0.71, p=0.48, Cohen's D = 0.12. The purchase price of pharmaceuticals obtained through the consignment system (M=0.76, SD=0.53) was higher when compared to the purchase prices in the hybrid system (M=0.72, SD=0.56) with t(128)=0.456, p=0.65, Cohen's D = 0.08.

The net percentage price change from tenders in 2019 to the tender-for-consignment (hybrid system) in 2022 shows that 61.5% (n=40) of products displayed a decrease in price ranging from 0.80% to 133.86% [Median = 9.625%; IQR = 17.39% - 3.18%]. Twenty-five products, however, displayed an overall increase in price when the procurement system changed from tenders to consignment to tenders-for-consignment. The percentage price increase ranged from 0.07% to 58.10% [Median = 7.43%; IQR = 3.1% - 27.075%] (Table 2).

The results indicate that of the 54 molecules selected for further analysis, 29.6% (n=16) appeared in the Kenya Essential Medicines List (2019) and 42.6% (n=23) appeared in the MSH International Medical Products Price Guide (2015). Table 3 distinguishes between the molecules that are listed in the Kenya Essential Medicines List (2019) and those that are not.

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Chemical Composition	Formulation	Strength	Kenya EML 2019 (Y/N)
Ciprofloxacin	Tablets	500mg	Y
Levofloxacin	Tablets	500mg	Y
Cefixime	Suspension	100mg/5ml (35ml)	Y
Cefuroxime	Tablets	500mg	N
Metronidazole	Injectible	5mg/ml	Y
Itraconazole	Capsules	100mg	Y
Clotrimazole	Pessaries	200mg	N
	Pessaries	100mg	
Aluminium oxide/Mg Hydroxide/Simethicone	Suspension	200ml	N
Aluminium Hydroxide/Mg Hydroxide/ Simethicone	Suspension	180ml	N
Sodium Alginate/Sodium bicarbonate/Calcium carbonate	Suspension	200ml	N
Esomeprazole	Tablets	20mg	N
		40mg	
Omeprazole	Capsules	20mg	Y
Rabeprazole	Tablets	20mg	N
Rabeprazole/Mosapride	Tablets	20mg/15mg	N
Dicyclomine/Paracetamol	Syrup	10mg/40mg	N
Hyoscine-N-butylbromide	Injectible	40mg	Y
Glycerine suppositories	Suppository	1g	N
		2g	
Albendazole	Tablets	400mg	Y
Hydrocortisone/Cinchocaine/Neomycin/Aesculin	Ointment	15gm	N
Zinc Oxide/Bismuth Oxide/Bismuth sabgallate/Balsum Peru	Ointment	25gm	N
	Suppositories	10's	
Tamsulosin	Tablets	0.4mg	Y
Aceclofenac	Tablets	200mg	N
Aceclofenac/Paracetamol/Chlorzoxazone	Tablets	100mg/500mg/500mg	N
Aceclofenac/Serratiopeptidase	Tablets	100mg/15mg	N
Ibuprofen/Paracetamol	Tablets	400mg/325mg	N
	Syrup	100mg/5ml	
Paracetamol	Effervescent Tablets	500mg	Y
		1g	
		240mg/5ml	
	Infusion	1g	
Paradichlorobenzene/Benzocaine/Chlorobutanol/Turpentine oil	Drops	10ml	N
Dydrogesterone	Tablets	10mg	N
Dexamethasone	Injectible	4mg	Y
Metformin/Glibenclamide	Tablets	500mg/5mg	N

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Chemical Composition	Formulation	Strength	Kenya EML 2019 (Y/N)
Vitamin B complex	Tablets	200mg/50mg/1000mcg	N
Ca Citrate, Vitamin D3, Mg, Zn	Tablets	1000mg/200IU/100mg/4mg	N
Carbonyl iron, folic acid	Tablets	100mg/500mcg	N
Adrenaline	Injectible	1mg/ml	Y
Cetrizine	Tablets	10mg	N
	Syrup	1mg/ml	
Levocetrizine	Tablets	5mg	N
Levocetrizine/Montelukast	Tablets	5mg/10mg	N
Montelukast	Tablets	5mg	Y
		10mg	
Salbutamol/Bromhexine/Guaifenesin/Menthol	Syrup	100ml	N
Terbutaline/Ambroxol/Guaifenesin/Sodium citrate/Levomenthol		100ml	N
Terbutaline/Bromhexine/Guaifenesin/Menthol	Syrup	100ml	N
Dextromethorphan/Triprolidine/Pseudoephedrine/Menthol	Syrup	100ml	N
Tetracycline	Ointment	0.01	Y
Betamethasone/Neomycin	E/E drops	7.5ml	N
Mupirocin	Ointment	15g	Y
Mupirocin/Betamethasone	Ointment	15g	N
Chlorhexidine/Metronidazole/Lidocaine	Gel	15g	N
Clotrimazole	Cream	15g	Y
Ketoconazole/Zinc pyrithione	Shampoo	200ml	N
Lindane	Lotion	75ml	N
Clotrimazole/Beclomethasone diproprionate	Cream	20g	N
Miconazole/Beclomethasone/Neomycin	Ointment	15g	N
Choline Salicylate/Benzalkonium chloride/Lidocaine	Gel	10g	N
Glucosamine/Chondroitin	Tablets	500mg/400mg	N

Table 3. List of essential versus non-essential medicines as per the Kenya Essential Medicines List 2019.

An analysis of the Essential Medicines showed similar trends as other drugs. When the procurement system changed from tenders in 2019 to consignment in 2020, the percentage price change ranged from -21.13% to 2,502.59% [Median = 10.29%; IQR = -2.85% - 69.20%]. Therefore, most essential medicines exhibited a price increase. With the introduction of tenders-for-consignment, the percentage price change ranged from -47.79% to 16.36% [Median = -10.47%; IQR = -22.00% - -4.46%]. All products except three displayed a price reduction when tenders-for-consignment was introduced. The net percentage price change ranged from -30.13% to 2,456.83% [Median = -1.13%; IQR = -13.45% - 7.06%]. Omeprazole 20mg capsules displayed the largest net price reduction, whereas Adrenaline 1mg injections showed the largest net price increase when the procurement system changed from tenders to consignment to tenders-for-consignment (Figure 1).

The researcher compared the mean unit purchase price with the MSH International Medical Products Price 2015 and calculated the mean unit purchase price to the MSH international reference price ratio. The mean unit buyer price in USD from the MSH international price guide was available for 23 out of the 54 molecules analyzed. The results show

that the ratio ranges from 0.3810 to 203.5284 [Median = 4.4319; IQR = 0.8496-12.6193] (Table 4).

Chemical Composition	Classification	Formulation	Strength	Mean price in USD	MSH International Price Reference 2015 in USD adjusted for inflation	Mean Price / MSH reference price ratio
Dexamethasone	Endocrine system	Injectible	4mg	0.1028	0.2698	0.3810
Albendazole	Infections	Tablets	400mg	0.1250	0.3229	0.3870
Adrenaline	Respiratory system	Injectible	1mg/ml	0.0855	0.2204	0.3881
Hyoscine N Butyl bromide	Gastrointestinal System	Injectible	40mg	0.1652	0.3649	0.4528
Glycerin	Gastrointestinal System	Suppository	1g	0.1297	0.1598	0.8111
Glycerin	Gastrointestinal System	Suppository	2g	0.1448	0.1705	0.8496
Cefuroxime	Infections	Tablets	500mg	0.5074	0.4206	1.2064
Tetracycline	Eye	Ointment	0.01	0.1848	0.1481	1.2480
Clotrimazole	Obstetrics, Gynaecology, and Urinary Tract Disorders	Pessaries	100mg	0.4244	0.2803	1.5140
Dydrogesterone	Endocrine system	Tablets	10mg	0.5667	0.2537	2.2340
Montelukast	Respiratory system	Tablets	5mg	0.2868	0.0959	2.9913
Itraconazole	Infections	Capsules	100mg	0.7333	0.1654	4.4319
Itraconazole	Infections	Capsules	100mg	0.7665	0.1654	4.6327
Ciprofloxacin	Infections	Tablets	500mg	0.1729	0.0308	5.6170
Levofloxacin	Infections	Tablets	500mg	0.4501	0.0775	5.8106
Omeprazole	Gastrointestinal System	Capsules	20mg	0.1530	0.0176	8.6812
Tamsulosin	Obstetrics, Gynaecology, and Urinary Tract Disorders	Tablets	0.4mg	0.5840	0.0516	11.3168
Cetrizine	Respiratory system	Tablets	10mg	0.1300	0.0103	12.6193
Paracetamol	Central Nervous system	Effervescent Tablets	500mg	0.0943	0.0066	14.2054
Metronidazole	Infections	Injectible	5mg/ml	0.2431	0.0045	54.4891
Clotrimazole	Skin	Cream	20g	1.8298	0.0129	141.5224
Cefixime	Infections	Suspension	100mg/5ml (35ml)	4.2525	0.0275	154.8600
Cetrizine	Respiratory system	Syrup	1mg/ml	1.1178	0.0055	203.5284

Table 4. Mean unit purchase price to MSH International Medical Products Price ratio

Liquidity was expressed as a ratio of current assets to current liabilities. In 2019, the inflation-adjusted current assets were valued at KES 362,859,455.63 and the current liabilities at KES 71,570,498.01. The liquidity ratio was 5.07. In 2020, after successfully implementing consignment for one year, the current assets were valued at KES 365,327,443.00 and the current liabilities at KES 65,942,724.00. The liquidity ratio increased to 5.54. The liquidity ratio improved by 9.3% after the introduction of consignment stock. To further evaluate the impact of consignment on liquidity, the researcher compared the closing stock of pharmaceuticals in the central stores as of 31st December 2019 and 2020. The total value of the closing stock as of 31st December 2019 was KES 7,329,125.30, and by the end of 2020, the value of the closing

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stock was KES 2,901,859.20, representing a 60.4% drop in stock holding and a direct cash saving of KES 4,427,266.10.

Discussion

Findings from the data analysis show that 81 molecules and 177 products listed by proprietary names were added to the hospital drug formulary between December 2019 and December 2021. Since tenders were not used as a form of procurement during this period, the addition of these products can be attributed to the implementation of inventory consignment. Gümüş et al. (2008) stipulate that an essential benefit of inventory consignment is that it allows the supplier to offer new or expensive products that the customer would otherwise be hesitant to stock. A consignment policy reduces the average inventory, creating more space for new products [12]. This benefit allowed the pharmacy to expand its formulary without incurring additional costs to acquire the products.

A price comparison between the tender system in 2019 and the consignment system in 2020 showed that 44.6% (n=29) of the products resulted in a price decrease and 55.4% (n=36) of the products showed a price increase when obtained through consignment. The increase in price can be attributed to the elimination of competition between suppliers. As seen in the Netherlands [13], China, and South Africa [6], tenders consistently result in lower purchase prices because of competition between pharmaceutical companies. Another reason for the price increase is that several of the importers/distributors who were supplying through tenders opted not to participate in consignment. These products were obtained on consignment through wholesalers. Interestingly, 29 products exhibited a price reduction with inventory consignment. In Kenya, the pharmaceutical supply chain is shown in Figure 2.

At every stage of the supply chain, a markup is added, resulting in a price increase. All 29 products that exhibited a price decrease with consignment were obtained directly from the importer/distributor, thus eliminating the wholesaler.

Towards the end of 2021, the hospital management adopted a hybrid procurement system that combines tenders and consignment. When tenders-for-consignment were advertised, several suppliers (wholesalers and importers/distributors) showed interest in participating. Comparatively, in 2020, when consignment was introduced, suppliers were approached individually. Therefore, many willing suppliers may not have been aware of the new procurement model. The fewer suppliers may have contributed to the increase in price seen in 2020. However, by reintroducing competition through tenders, the hybrid system showed that more than half (n=43) of the products resulted in a decrease in price. Surprisingly, of the 22 products that exhibited a price increase, 16 products showed a price decrease when consignment was introduced in 2020. This can be attributed to the administrative challenges of implementing inventory consignment. The manual reconciliation of goods consumed against the invoice raised is a very time-consuming process that can result in delays in payment to suppliers. In the case of the 22 products that exhibited a price increase with the hybrid system, two importers/distributors opted out of consignment, citing delays in payment as a major challenge. Thus, these 22 products were obtained on consignment but through a wholesaler. It is essential to invest in information technology (IT) systems that automate the tracking and administration of consigned goods [14]. The IT system in BH was not equipped to handle inventory through consignment, resulting in many of the processes being conducted manually. Overall, 40 products displayed a decrease in price when the procurement system changed from tenders in 2019 to tenders-for-consignment in 2022, indicating a clear advantage of the tendering system in obtaining the most favorable price.

A subset of the data collected comprised essential medicines (n=16). The price trend for essential medicines is similar to the trend observed with the full dataset. When the procurement method changed from tenders to consignment, the essential medicines displayed a price increase. When tenders-for-consignment were introduced, the price was reduced. A net percentage price reduction was observed from tenders to tenders-for-consignment. It is important that essential medicines are affordable and available to ensure access to healthcare services. Consignment resulted in a median price increase for essential medicines, which, when coupled with the low available disposable income, would further affect the affordability of medicines [4].

A comparison of the mean unit purchase price with the MSH International Medical Products Price 2015 for 23 molecules revealed that the ratio ranges from 0.3810 to 203.5284. Of the 23 molecules compared, only six drugs resulted in a ratio of less than one. According to the MSH, the procurement price for generic drugs should be close to the MSH international buyer/supplier price, with a ratio close to 1 [15]. The results from this study show that the median ratio is 4.4319. This shows that neither of the procurement methods resulted in purchase prices that are comparable to the MSH international buyer price, further questioning the affordability of medicines in BH.

A significant benefit of inventory consignment is the immediate cash flow generated and savings accrued [14]. Eagle et al. (2002), Park & Dickerson (2009), and Wilson et al. (1992) show how implementing consignment resulted in millions in savings. Similarly, BH experienced a direct cash saving of KES 4,427,266.10 as the closing stock of pharmaceuticals reduced from KES 7,329,125.30 to KES 2,901,859.20 between December 2019 and December 2020. The liquidity ratio improved by 9.3% over the same period.

Limitations

Only 65 products listed by proprietary name were included in the study. This represents less than 10% of the total formulary. Therefore, the results may not be generalizable to all products. Other factors such as changes in import duties, changes in logistic fees with the introduction of the standard gauge railway (SGR), and the effect of the COVID-19 pandemic on imports were not accounted for during the analysis.

Conclusion

The findings indicate that, although not significant, tenders resulted in the most favorable prices; however, they required capital to be invested in inventory. With consignment, inventory is stored at the user's premises but owned by the supplier until consumed, at which point there is a transfer of ownership. Inventory consignment resulted in substantial financial savings for the institution, which can be used for other income-generating activities. However, consignment eliminates competition between suppliers, resulting in an increase in the price of pharmaceuticals, thereby negatively affecting the affordability of medicines. Combining tenders and consignment resulted in the organization benefiting from reduced prices due to tenders and accruing financial savings due to consignment. However, a well-defined contractual agreement, information sharing between the buyer and the supplier, and a robust IT system are paramount for the successful implementation of inventory consignment.

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Declarations

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