



ISSN: 2230-9926

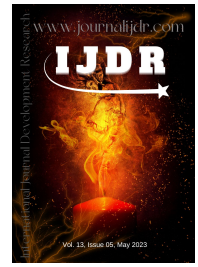
Available online at <http://www.journalijdr.com>

# IJDR

International Journal of Development Research

Vol. 13, Issue, 05, pp. 62800-62805, May, 2023

<https://doi.org/10.37118/ijdr.26699.05.2023>



RESEARCH ARTICLE

OPEN ACCESS

## ANALYSIS OF INVENTORY MANAGEMENT IN PHARMACEUTICAL SECTOR: A REVIEW PAPER

\*Disha Singh

Research Scholar, Faculty of Commerce, Banaras Hindu University, Varanasi

### ARTICLE INFO

#### Article History:

Received 11<sup>th</sup> March, 2023

Received in revised form

14<sup>th</sup> April, 2023

Accepted 25<sup>th</sup> April, 2023

Published online 30<sup>th</sup> May, 2023

#### KeyWords:

Inventory Management, Pharmaceuticals, Various techniques, Managing Inventory.

\*Corresponding author: Disha Singh,

### ABSTRACT

The study utilizes the inventory review technique to develop the status of pharmaceutical industry by using various inventory control techniques. Pharmaceutical sector plays a crucial role in the medical industry. The pharmaceutical industry is always looking for novel treatments that can help people live longer and live healthier lives. The study uses a systematic literature review using various statistical methods like ABC-VED, JIT, EOQ, Fuzzy logic, FNS etc. The classification of various pharmaceutical inventory model is incorporated on the basis of these methods. In this study, all of the primary approaches to drug handling inventory management are examined, and the most effective approaches are identified as those that, when combined and utilized in an automated setting, can aid in maintaining inventory levels at their optimal levels.

Copyright©2023, Disha Singh. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Disha Singh. 2023. "Analysis of inventory management in pharmaceutical sector: A Review paper". *International Journal of Development Research*, 13, (05), 62800-62805.

## INTRODUCTION

The development of efficient and effective healthcare systems has emerged as an essential area of concern for governments and healthcare decision-makers as a result of the rapid growth in healthcare spending worldwide and simultaneous growth in demand for healthcare services (Amir Ahmadi-Javid 2017). Due to increased competition and decreased profit margins, the manufacturing industry as a whole from the extraction of raw materials through production at various stages of the supply chain to the final customers has seen a growing demand for effective behavior (Henrik Andersson et.al 2010). Inventory refers to the merchandise or materials involved by a firm for the reasons for creation and deal. Typically, nearly 60% of operational cash is set aside for project inventory (Subramani, et.al 2017). To keep materials at the lowest possible costs, effective inventory management is essential. In order to improve inventory cost efficiency, businesses need to implement better internal control measures like establishing policy, enhancing employee capacity, and so on. Inventory management: Ordering, storing, making use of, and selling a company's inventory is known as inventory management. Management of raw materials, components, and finished goods, as well as their storage and processing, are all included in this (Hayes, 2022). Inventory management is described as a process of planning, organizing and controlling inventory by balancing the demand and supply which ultimately minimizes the investment in inventory.

An important part of a business is inventory management, which contributes to the growth of a business. This involves ordering, storing and managing a company's inventory management. Inventory represents a large part of current assets as well as liquid assets in pharma industries and its value rises with the growth and cost of pharma products (West D). An effective inventory management enables meeting customer demands. When a product is not available, it causes customer inconvenience.

**Overview of Pharmaceutical Industry:** Management of pharmaceutical supply is one of the crucial managerial issues in health care industries. The pharmaceutical industry contributes to innovative research and engages in technological advances to meet complex medical needs, thereby preventing and reducing disease incidence, treating medical conditions and improving quality of life. plays an important role in the development of vaccines and medicines for population. The industry's primary goal is to provide medicines to maintain health, prevent infections, and cure diseases affecting the world's population. The pharmaceutical industry is liable for the production, distribution and research and development of medicines. The pharma market has grown significantly over the past two decades and in 2021, pharmaceutical revenues world wide reached 1.42 trillion US dollars.

**Pharmaceutical Industry in India:** Pharmaceutical industry in India is ranked third in the pharmaceutical production in terms of volume and is growing at a CAGR of 9.43%.



Source: IBEF Report

**Pharmaceutical Industry in India:** Pharmaceutical industry in India is ranked third in the pharmaceutical production in terms of volume and is growing at a CAGR of 9.43%

Key highlights of Indian Pharmaceutical Industry:

- It supplies over 50% of global demand.
- It includes a network of 3,000 drug companies and 10,500 manufacturing units.
- India enjoys a prominent position in global pharmaceuticals.
- It is the 12<sup>th</sup> largest exporter of medical goods in the world.
- Generic drugs accounts for 20% of global export in global volume.

The basic financial inventory management point is holding the stock to minimal level according to its expenses. Using capital to finance inventory and linking inventory storage, insurance, transportation, obsolescence, waste, and spoilage costs are all aspects of holding inventory. However, maintaining a low inventory level can result in additional issues when it comes to meeting demand for supplies (Michalski Grzegorz 2008).

**Problem with managing excess inventory:** One of the key component of logistics and supply chain management is inventory management (Murphy and Wood 2014). A business function in improper way when it comes to excess inventory. Customers demand is satisfied when a firm maintains a sufficient amount of inventory or stock (Murphy and wood 2014). Managing of excess inventory has a substantial effect on short term cost and long- term market position. They are not the primary focus of a company, since they are considered by- product of the main business. Information sharing is essential. The better information we have from our customers and suppliers, the more effective our excess inventory management program will be. Sophisticated inventory management require a process of balancing related inventories. Features that prevent sub optimization and ultimately results in a cost- effective overall solutions (Rushton et al. 2011).

### Need to hold Inventories

There are three motives to hold Inventories:

1. **Transaction Motive:** This emphasizes on the need to maintain inventories for the smooth operation of the business.
2. **Precautionary Motive:** This helps to hold inventories to safeguard against the unforeseen risk of fluctuation in demand and supply and other factors
3. **Speculative Motives:** A firms has to decide whether to increase or decrease the level of inventory which helps to take the advantage of changes in price fluctuations.

### Literature Review

- (Danas et al, 2002): This paper aims to study the pharmaceutical logistics operations amongst the VHP program

and consolidated inventory management system. The idea of Just-In-Time and information network are proposed by the authors. This network will replace the hospital pharmacy with a virtual pharmacy and distribute the actual drug stock to all hospital clinics in the same region. Problems like medicine that is out of stock or has expired, which makes it easier for health care professionals to focus on important research rather than inventory management and reduces or eliminates their role significantly.

- (Gupta et.al, 2007): The primary focus of this paper was on the ABC inventory control method, which is based on the cost factor, and the VED method, which is based on the critical factor. The objectives of this study are to discuss the financial analysis of drug costs in a medical store with 190 bed service in mind. According to the ABC-VED matrix, 63 of 292 items belong to class 1, 164 to class 2 and 65 to class 3. The study indicates that as long as the purpose of inventory management is considered, they could control the drugs that are recommended or group A, but it would make it harder to get essential drugs in categories B and C. The authors inferred that the expense factor played a significant role in maximizing asset utilization.
- (Nigah et.al, 2010): This research focuses on PGIMER analysis of the pharmacy shop in order to classify the kinds of items that require strict management control. The stock control strategies, i.e. VED, ABC, and ABC-VED, have also been analyzed for each pharmacy item's annual use and expenses for 2007-2008. These analyses classify medications as less likely to be produced in pharmacies and as requiring strict control over how funds are used. To reduce non-restrictive situations and maximize resource utilization in pharmaceutical hospitals, such approaches must be used routinely.
- (Mahendrawathi et.al, 2011): The authors in their study aims to study the inventory management of pharmaceuticals drugs in hospital using Fuzzy ABC and a combination of ABC and Fuzzy method. This method helps to assimilate numerous variables into inventory management decisions. The items are prioritize on the basis of their relevance through the analytical hierarchy method (AHP) and to maximize the artificial inventory, the Data Envelopment Analysis was preferred. To calculate dollar usage and inexpressible variables, the fuzzy ABC method was used to capture the intuition behind the value of pharmaceutical components.
- (Ramasamy et.al, 2012): The review expects to arrange the medication as indicated by cost and analysis and that necessary need severe administration. The pharmaceutical medicines were divided on the basis of ABC and VED analysis. The categorization is based on cost and criticism factors. This is based on promoting effective inventory management by maintaining safety requirement and minimum monetary resources. At primary care, uncompromising patient care can result from an efficient inventory management programe.
- (Mahatme et.al, 2012): The authors in the study aims to highlight the significance of financial analysis in the management of pharmaceutical stores. The study focus on ABC-VED analysis with EOQ. The authors investigate that the hospitals spent 7.68% of their annual budget on pharmaceuticals between 2010 and 2011. Consequently, ABC-VED, in conjunction with EOQ and applied economic analysis, optimizes the cost of Medicare services and makes money available to patients to improve health care quality.
- (Kapoor et.al, 2012): A modern outpatient pharmacy information system that addresses features of distribution and inventory, improves service rates for its members and significantly lowers product costs will be built and implemented using the Titan Healthcare JIT (Just-In-Time) method. As a result, Titan has established a JIT inventory management system to lessen the Bullwhip Effect, reduce safety stocks, and increase supply reliability.
- (Manhas et.al, 2012): The authors in this study find out how expensive pharmacy drugs are and how critical they are. The VED analysis is attempted to be used in the study for the critical

- drug factor and the ABC analysis for the cost criteria. A total of 156 products were tested for a year. The authors anticipate that the findings will assist in regulating pharmaceutical company prices and ensuring that patients and hospital administrators have access to vital and essential medications. They also suggested looking into the deals counter stock, which includes more expensive medicines with bigger financial implications and could help with cost reserve funds.
- (Gustriansyah et.al, 2015): A system for pharmaceutical inventory management that supports decision-making is the highlight of this paper. Forecasts of inventory are made using DSS, FAHP, and SPA methods when the pharmacy inventory manager's average accuracy exceeds DSS's average accuracy in order to increase efficiency. As a result, this approach can be utilized to support decision-making and improve pharmacy inventory management.
  - (Singh et.al, 2015): The investigation of ABC and VED matrices in a pharmacy, as well as their teaching, testing, and other aspects, is the focus of this research. which specifically requires strict management oversight. The objective of this investigation was to assess yearly drug use by utilizing the need model in view of examination of the ABC-VED lattice for the years 2008-2009 also, 2009-20010. In PGIMER, ABC and VED (in pharmacy/drug store) analyses were carried out to identify drug categories that require significant management controls.
  - (Santhi and Karthikeyan 2016): The study aims to reduce medication costs through inventory management utilizing ABC-VED analysis. The analysis was made on the basis of RFID based pharmaceutical Inventory management. A new model called as AVSER matrix was developed with the combination of ABC and VED analysis. This makes the process much easier and efficient.
  - (Migbaru et.al, 2016): The purpose of this study was to assess the Tikur Anbessa Advanced Clinic TASH drug stock during 2009-2016. The study was based on VEN, ABC, and ABC/VEN analysis with a five year evaluation (2009-2013) based on cross-sectional study of this matrix. The study's findings suggested that scientific tools like ABC-VEN matrix analysis, which can be used to manage pharmaceutical inventories, should be regularly used to increase resource efficiency and patient consideration quality.
  - (Agada and Ogwuche 2017): At the Benue State University Teaching Hospital, the quality of the health services provided by Central Pharmacy was the focus of this paper's research. Strong patient demand for a variety of care facilities constantly threatens the high demand for various pharmacies. The tertiary health care system as well as a prompt intervention are crucial for resolving the inventory issue mentioned earlier. The Probabilistic EOQ model was used to determine the degree of reorder and the amount of economic order (EOQ) for each consumable hospital and drug in this study.
  - (Ceylan and Bulkan 2017): Using ABC, VED, and ABCVED analyses, this study aimed to efficiently control the pharmacy's product inventory as well as to maintain a healthy drug rate balance. It also aimed to classify essential and economical medications. In order to strictly control inventory and make the most of the budget, the data have been reviewed. The item's quality and rate of use are the foundation of ABC analysis; The medications are categorized by VED analysis based on how critical they are related to the safety of their patients. Efficient inventory management is impossible if only VED or ABC analysis is used. As a result, the ABC-VED matrix, together with ABC and VED, was created. It offers tight command over the meds for ideal use in the financial plan.
  - (Fitriana et.al, 2018): The authors in the study aims to examine the drug consumption goods and cost of procurement on the basis of traditional inventory management. The study used the ABC and VED analysis to solve the drawback. For an effective and efficient monitoring of inventories, ABC-VED matrix was used. The proper implementation of ABC-VED matrix is beneficial under hospital drug control.
  - (Kanyakam et.al, 2018): An inventory management model is presented in this study with the intention of increasing patient quality in the secondary hospital unit in the northeast of Thailand by enhancing successful medical inventory controls. The ABC-VED matrix analytical model was proposed to identify and describe critics of the drug items being analyzed. Economic order quantity (EOQ) and the reorder point model were used to calculate the AE Subcategory I application, which was estimated using the exponential smoothing method based on regression.
  - (Mansoor et.al, 2019): The primary objective of this paper was to outline an effective stock administration strategy that would help to upgrade assets and at last work on persistent consideration using stock administration systems to limit capacity and inside lead times. ABC and VED methods were used by the creators to identify delicate consumables. From the ABC investigation, 35, 52, and 171 things were ordered as A, B, and C, separately. According to the study's findings. 73% of the items in the VED analysis were considered to be the most important, and 26% of the items fell into the essential category. The internal, external, and total periods had an average lead time of 17, 25, and 44 days, respectively.
  - (Taddele et.al, 2019): An ABC-VEN matrix analysis of the hospital inventory and the identification of drugs requiring close supervision were the primary goals of the study. This investigation focuses primarily on the ABC-VEN examination-based stock administration of drugs in Sudan's medical clinics. To get data in regards to the yearly financial plan for ABC, VEN, and ABC-VEN lattice research as well as the control of drug inventories, the information (NMSF and RDF) were explored with the assistance of an extraordinary spread sheet.
  - (Ahmed et.al, 2019): This investigation focuses primarily on the ABC-VEN examination-based stock administration of drugs in Sudan's medical clinics. To get data in regards to the yearly financial plan for ABC, VEN, and ABC-VEN lattice research as well as the control of drug inventories, the information (NMSF and RDF) were explored with the assistance of an extraordinary spread sheet. The pharmacists employed at centers' inventory system knowledge was assessed using Sustainable Frameworks. Staff in drug treatment ought to be furnished with broad scholastic preparation and incessant studios or courses regarding the matter.
  - (Mohammed and Workneh 2020): The study aims to analyze the inventory management of Dessie Referral hospital. The study is based on ABC-VEN matrix for a period of four years i.e, 2013-2017. The study examines that an sufficient amount of inventory is required to maintain and therefore there should be a strict control of inventory to reduce the wastage and excess capital in buffer stock.
  - (Almahdy et.al, 2021): The authors in their study aims to evaluate the control of medicines supplies in a sufficient quantity at the time needed and at the lower cost. The study was carried out using a quantitative research method for the period 2018-2020. The data was analysed using EOQ and VEN analysis. The study analysed that an accurate planning and forecasting in purchases of drugs is required to avoid stock out. An up to date database for planning and controlling of inventory by creating a management information system which simultaneously minimize delays in procurement.
  - (Gizaw & Jemal 2021): The goal of the study is to determine the Ethiopian Pharmaceutical Supply Agency's efficient and effective inventory control. The review was completed utilizing cross sectional unmistakable concentrate on 393 Drugs. ABC, VED and FNS analysis was carried out to interpret the data. To implement the inventory control policies and techniques, to prioritize a location plan and minimize the time and labor cost, this ABC-VED-FNS matrix will help the organization.
  - (Soraya et.al, 2022): The authors in the study aims to examine a suitable inventory management that can be used in hospital pharmacy supply using an optimum number of orders in pharmaceutical supply. The study uses ABC-VEN analysis and EOQ.

Table 1.

Sr.No.	Year	Author's	Techniques of Inventory management							
			ABC	VED	JIT	EOQ	DSS-FUZZY	VEN	FSN-XYZ	FNS
1.	2002	Danas et al			✓					
2.	2007	Gupta et al	✓	✓						
3.	2010	Nigah et al.	✓	✓						
4.	2011	Mahendrawathi et al.	✓							
5.	2012	Ramasamy et.al	✓	✓						
6.	2012	Kapoor et.al			✓					
7.	2012	Mahatme et.al	✓	✓						
8.	2012	Manhas et.al	✓	✓						
9.	2015	Gustriansyah et.al					✓			
10.	2015	Singh et.al	✓	✓						
11.	2016	Santhi and Karthikeyan	✓	✓						
12.	2016	Migbaru et.al	✓							
13.	2017	Agada and Ogwuche				✓				
14.	2017	Ceylan and Bulkan	✓	✓						
15.	2018	Fitriana et.al	✓	✓						
16.	2018	Kanyakam et.al	✓	✓		✓				
17.	2019	Chihaoui et.al					✓			
18.	2019	Ahmed et.al	✓					✓		
19.	2019	Mansoor et.al	✓	✓						
20.	2019	Taddele et.al	✓	✓						
21.	2020	Mohammed & Workneh	✓					✓		
22.	2021	Almahdy et.al				✓		✓		
23.	2021	Gizaw & Jemal	✓	✓						✓
24.	2022	Soraya et.al	✓					✓	✓	
25.	2022	Jobira et.al	✓	✓					✓	
26.	2023	Mfizi et.al	✓					✓		

Source: Author Compilation

The research method used in the study is analytical descriptive research. The study analysed that ABC-VEN and EOQ method can improve medicine supply efficiency in hospital.

- (Jobira et.al, 2022): The study aims to appraise the inventory management in health facilities of West Arsi zone for the period 2016-2018. The study was carried out using cross sectional descriptive research in fourteen health facilities. The study was carried out using cross sectional descriptive research in fourteen health facilities. The study was conducted using ABC-VEN matrix and FSN-XYZ matrix. The study examines that for an efficient and optimized inventory, the consumption pattern and their closing stock value in forecasting gives an accurate stock level.
- (Mfizi et.al, 2023): The aim of the study is to examine the inventory management of pharmaceutical using ABC-VEN analysis. The study considered 457 items and was conducted at Rwanda Medical Supply (RMS) Ltd. For the period 2017 to 2020. The results revealed that antibiotics, antihypertensive commodities are the most used and are of high importance. The study also aims to update the categories related to local and national commodities.

### Techniques of Inventory Control

1. ABC Analysis: Always Better Control (ABC) is a technique of inventory management that ascertain the value of inventory on the basis of cost to the company. It recognize the items on the basis of its significance and make sure that the items are categorized on the basis of its value. They are classified as below:  
A Class: 10% to 20% of items – 70 to 80 % of total cost  
B Class: 10% to 20% of items- 15 to 20% of overall total cost  
C Class: 60% to 80% of items- 5% to 10% of overall total cost
2. VEN Analysis: This analysis is based on criticality. For an effective inventory management, VEN analysis is considered significant since it categorize the medicines on the basis of functional importance as Vital, Essential and Normal (Yitayew 2014).

Vital drugs- useful in providing basic healthcare

Essential drugs- useful in major illness, not required for basic health care

Normal drugs- useful for self - limiting illness, normal drugs are used.

3. ABC- VEN matrix analysis: This technique is a combined technique derived from the cross tabulation of ABC and VEN analysis. This method is used to analyze a management system which can be used to control cost. The combination of all categories are below:  
Group I - V and E items (AV,BV,CV,AE,AN)  
Group II - Spare items of E and B (BE,CE,BN)  
Group III - Items of normal and cheaper group (Vaz F, et.al)
4. XYZ analysis: This analysis is based on the value of stock by classifying all the items into X,Y&Z categories on the basis of demand volatility. The categorization are as follow:  
X- represents regular demand accounts for 70% of total inventory  
Y- items represents 20% based on demand variability  
Z- represents fluctuating or asymmetrical demand accounts for remaining 10%
5. FSN analysis: This analysis is based on the frequency of issue i.e, rate at which items are issued. This technique divide the inventory into three clusters:  
F (Fast moving items)- issued more than 15 times in a year  
S (Slow -moving items)- issued at least 5 to 15 times  
N (Non- moving items)- issued less than 5 times
6. FSN-XYZ matrix: This matrix is a combined technique derived from the cross tabulation of FSN and XYZ matrix (Devarajan D). This analysis identifies the items that is discarded and the amount saved. 9 sub categories of the items are obtained as follows:  
Group I- FX+FY+ FZ+SX+NX  
Group II- SY+SZ+NY  
Group III- Non- moving, low value items, NZ (Vaz F, Ferreira)
7. Economic Order Quantity: The ideal quantity which a company purchases to minimize the inventory cost. When a firm buys a raw material, it has to decide the quantity in which it has to be

purchased. The firm determines the optimum quantity needed for the business operation called the Economic Order Quantity.

8. Just-in-Time (JIT): JIT is a method that tries to replenish inventory for businesses only when it is needed. It will be the method of choice for very expensive inventory items, which are items with low demand but relatively high purchase prices, holding costs, or ordering costs. The model tries to stay away from the costs that come with having too much inventory. An essential prerequisite for the outcome of the JIT approach is for the merchant to follow through on time. This is to avoid inventory delivery delays, which are a major operational management issue for many Nigerian manufacturers and cause costly and irreparable business downtimes (Takim, 2014). JIT is used as a production scheduling strategy on single and parallel machines, but it is beginning to be considered on flow shop machines (Adamu et al, 2014).

**Research Methodology and Analysis:** The study aims to evaluate the inventory management techniques utilized in various pharmaceutical industry using a systematic literature review. The study is descriptive in nature based on secondary data. The time period used for review paper was taken from 2002 to 2023 collected from various journals, research papers, articles, reports and websites.

## CONCLUSION

Throughout the course of this study, numerous different methods, such as ABC, VED, EOQ, and JIT, were used. Various papers related to Pharmaceutical Inventory Management have been examined one by one, and the results suggest that, for an effective inventory management, the aforementioned methodological principles can be combined in an automated setting to maintain stocks at their highest possible level. While limiting misfortunes because of terminated medications and postpones in requesting new stocks, we can limit costs because of the low inventories (JIT) idea also, the high accessibility of medications in light of their basic factor. The outcome of the research analysis establish a consistent and statistically significant result with previous studies.

## REFERENCES

- Agada, P. O. & Ogwuche, E. H. (2017). A Probabilistic Economic Order Quantity (EOQ) Model for Inventory Management Of Drugs And Hospital Consumables. Department of Mathematics/Statistics/Computer Science Journal
- Ahmed, H. A., Kheder, S. I., & Awad, M. M. Pharmaceutical inventory control in Sudan central and hospital stores using ABC-VED analysis.
- Almahdy, I., Kholil, M., Haekal, J., & Widodo, T. (2021). Control Analysis of Medicine Inventories Using ABC, VEN, and EOQ Approach in Pharmaceutical Companies. *MEDICINE*, 25000000, 30000000.
- Andersson, H., Hoff, A., Christiansen, M., Hasle, G., & Løkketangen, A. (2010). Industrial aspects and literature survey: Combined inventory management and routing. *Computers & operations research*, 37(9), 1515-1536.
- Basha, M. M. J., VS, N., Wani, S., & Gogi, V. (2020). Study of inventory management in pharmaceuticals: A review of COVID-19 situation. *Int. J. Innov. Sci. Res. Technol*, 5, 366-371.
- Basha, M. M. J., VS, N., Wani, S., & Gogi, V. (2020). Study of inventory management in pharmaceuticals: A review of COVID-19 situation. *Int. J. Innov. Sci. Res. Technol*, 5, 366-371.
- CEYLAN, Z., & BULKAN, S. (2017). Drug inventory management of a pharmacy using ABC and VED analysis. *Eurasian Journal of Health Technology Assessment*, 2(1), 14-18.
- Chihoui, F. B., Maddeh, N., Layeb, S. B., Hamouda, C., & Chaouachi, J. (2019, April). A Decision Support System for Drug Inventory Management within an Emergency Department: A Case Study. In 2019 6th International Conference on Control, Decision and Information Technologies (CoDIT) (pp. 1889-1894). IEEE
- Coker, R., Rushton, J., Mounier-Jack, S., Karimuribo, E., Lutumba, P., Kamarage, D., ... & Rweyemamu, M. (2011). Towards a conceptual framework to support one-health research for policy on emerging zoonoses. *The Lancet infectious diseases*, 11(4), 326-331.
- Danas, K., Ketikidis, P., & Roudsari, A. (2002). A virtual hospital pharmacy inventory: An approach to support unexpected demand. *Journal of Medical Marketing*, 2(2), 125-129.
- Devarajan, D., & Jayamohan, M. S. (2016). Stock control in a chemical firm: combined FSN and XYZ analysis. *Procedia Technology*, 24, 562-567.
- Fitriana, I., Satria, R. G. D., & Setiawan, D. C. B. (2018). Medicine Inventory Management by ABCVED Analysis in the Pharmacy Store of Veterinary Hospital, Yogyakarta, Indonesia. *Asian Journal of Animal and Veterinary Advances*, 13(1), 85-90
- Gizaw, T., & Jemal, A. (2021). How is Information from ABC-VED-FNS Matrix Analysis Used to Improve Operational Efficiency of Pharmaceuticals Inventory Management? A Cross-Sectional Case Analysis. *Integrated Pharmacy Research and Practice*, 65-73.
- Grzegorz, M. (2008). Value-based inventory management. *Romanian Journal of Economic Forecasting*, 9(1), 82-90.
- Grzegorz, M. (2008). Value-based inventory management. *Romanian Journal of Economic Forecasting*, 9(1), 82-90.
- Gupta, R. K. G. R., Gupta, K. K., Jain, B. R., & Garg, R. K. (2007). ABC and VED analysis in medical stores inventory control. *Medical Journal Armed Forces India*, 63(4), 325-327.
- Gustriansyah, R., Sensuse, D. I., & Ramadhan, A. (2015, November). Decision support system for inventory management in pharmacy using fuzzy analytic hierarchy process and sequential pattern analysis approach. In 2015 3rd International Conference on New Media (CONMEDIA) (pp. 1-6). IEEE  
<https://www.jli.edu.in/blog/pharmaceutical-industry-overview/>
- Hussain, M., Siddharth, V., & Arya, S. (2019). ABC, VED and lead time analysis in the surgical store of a public sector tertiary care hospital in Delhi. *Indian journal of public health*, 63(3), 194.
- Jobira, T., Abuye, H., Jemal, A., & Gudeta, T. (2021). Evaluation of pharmaceuticals inventory management in selected health facilities of West Arsi Zone, Oromia, Ethiopia. *Integrated Pharmacy Research and Practice*, 1-11.
- Jobira, T., Abuye, H., Jemal, A., & Gudeta, T. (2022). Assessment of Knowledge, Practices, and Challenges of Pharmaceuticals Inventory Control Among Pharmacy Professionals Working in Selected Public Health Facilities of West Arsi Zone, Oromia, Ethiopia. *Health Services Insights*, 15, 11786329211066403.
- Kanyakam, S., Pimpa, W., & Kamlai, K. (2018). Inventory Management in Medical Stores of Secondary Care Unit Service Level Hospitals in Northeast of Thailand. *Mahasarakham International Journal of Engineering Technology*, 4(1), 17-23
- Kapoor, B., & Mullen, T. (2012). Integration of Just In Time (JIT) Inventory in Outpatient Pharmacy Information Systems. *Journal of Cases on Information Technology (JCIT)*, 14(4), 27-40.
- Mahatme, M. S., Hiware, S. K., Shinde, A. T., Salve, A. M., & Dakhale, G. N. (2012). Medical store management: An integrated economic analysis of a Tertiary Care Hospital in Central India. *Journal of Young Pharmacists*, 4(2), 114-118
- Mahendrawathi, E. R., Laili, E. N., & Kusumawardani, R. P. (2011, December). Classification of hospital pharmaceutical drug inventory items by combining ABC analysis and fuzzy classification. In 2011 International Conference on Advanced Computer Science and Information Systems (pp. 215-220). IEEE
- Mallick B, Dutta ON, Das S. A case study on inventory management using selective control techniques. *J Assoc Eng India*. 2012;82:10.29. Devarajan D, Jayamohan MS. Stock control in a chemical
- Management Sciences for Health. Analyzing and controlling pharmaceutical expenditure. Managing Access to Medicines and Health Technologies. 3rd ed. MSH;2012;40.2-40.25.5. Nahamya
- Manhas Anil, K., Aubid, M., Haroon Rashid, S. M. A., & Syed, A. T. (2012). Analysis of inventory of drug and pharmacy department of a tertiary care hospital. *Analysis*, 25(3), 183

- Mfizi, E., Niragire, F., Bizimana, T., & Mukanyangezi, M. F. (2023). Analysis of pharmaceutical inventory management based on ABC-VEN analysis in Rwanda: a case study of Nyamagabe district. *Journal of Pharmaceutical Policy and Practice*, 16(1), 1-6.
- Migbaru, S., Yigeremu, M., Woldegerima, B., & Shibeshi, W. (2016). ABCVEN 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*, 5, 734-743
- Mohammed, S. A., & Workneh, B. D. (2020). Critical analysis of pharmaceuticals inventory management using the ABC-VEN matrix in Dessie referral Hospital, Ethiopia. *Integrated Pharmacy Research and Practice*, 113-125.
- Nigah, R., Devnani, M., & Gupta, A. K. (2010). ABC and VED analysis of the pharmacy store of a tertiary care teaching, research and referral healthcare institute of India. *Journal of young pharmacists*, 2(2), 201-205.
- Ramasamy D, J. et al. (2012). Drug Inventory control analysis in a Primary level Health care facility in Rural Tamil Nadu, India. age, 3, 6.
- Santhi, G., & Karthikeyan, K. (2016). Recent review article on pharmaceutical inventory models. *International Journal of Pharm Tech Research*, 9(5), 435-443
- Singh, S., Gupta, A. K., & Devnani, M. (2015). ABC and VED analysis of the pharmacy store of a tertiary care, Academic Institute of the Northern India to identify the categories of drugs needing strict management control. *Journal of Young Pharmacists*, 7(2), 76
- Soraya, C., Surwanti, A., & Pribadi, F. (2022). Drug Inventory Management Using ABC-VEN and EOQ Analysis for Improving Hospital Efficiency. *Jurnal Aisyah: Jurnal Ilmu Kesehatan*, 7(1), 373-382.
- Subramani T, Nair V B, David A, Ghose B M and Kumar N S 2017 A Study of Inventory Management System in Construction Industry *International Journal of Application or Innovation in Engineering & Management* 6(5) 304-311
- Taddele, B. W., Wondimagegn, A. A., Asaro, M. A., Sorato, M. M., Gedayi, B. G., & Hailesilase, A. A. (2019). ABC-VEN matrix analysis of the pharmacy store in a secondary level health care facility in Arbaminch Town, Southern Ethiopia. *Journal of Young Pharmacists*, 11(2), 182.
- Vaz F, Ferreira A, Pereira-Antao I, Kulkarni M, Motghare D. Application of inventory control techniques for drug management. *Indian J Prev Soc Med*. 2008; 39:39-42

\*\*\*\*\*