INVENTORY MANAGEMENT OF A NAVAL MEDICAL CENTER PHARMACY

Jason Galka, Customer Pharmacy Operations Center (CPOC) Medical Supply Chain DLA Troop Support, 700 Robbins Street. Philadelphia, PA 19111, 215-737-3837, Jason.galka@dla.mil
Nasr-Eddine Dahel, Graduate School of Business & Public Policy, Naval Postgraduate School, 555 Dyer Road, Monterey, CA 93943, 831-656-2187, edahel@nps.edu

ABSTRACT

This paper examines the use of two inventory control systems the periodic review and the continuous review systems with single item ordering and joint item ordering at one of the largest pharmacies in Navy Medicine, the Naval Medical Center San Diego (NMCSD) Pharmacy. Also, proposed in this paper is an inventory classification system of medications that combines the traditional ABC classification of inventory items with the VEN system of medications. Results from this study show that a joint ordering with continuous review inventory policy to be more efficient and less expensive than a single item ordering and periodic review policy.

Keywords: Inventory Management, Pharmacy, Military

INTRODUCTION

Inventory management practices in Navy pharmacies are today largely based on ineffective approaches and are desperately in need of updating. Reorders are initiated daily by visually inspecting thousands of SKUs stored on shelves, leading to numerous shortages and higher inventory costs.

Each year all of the services across the Department of Defense (DOD) spend billions of dollars filling prescriptions using one of three options: Military Treatment Facility (MTF) pharmacies, Tricare Mail Order Pharmacy (TMOP), or retail pharmacies. For the government and the Tricare beneficiary, the most expensive option is to fill a prescription using the retail network [12]. Through various incentive-based plans, the DOD is trying to shift demand from the retail networks the MTF pharmacies or TMOP [12]. With 9.6 million Tricare beneficiaries in 2012 [7], many of whom fill at least one prescription every year, this would result in millions of prescriptions to fill throughout the DOD.

This paper will examine the inventory management of one of the largest pharmacies in Navy Medicine, Naval Medical Center San Diego (NMCSD) Pharmacy, however many of the ideas and conclusions drawn can be extrapolated to benefit all DOD pharmacies. The focus will be on the management of the outpatient division and will not include the demand for inpatient medications. Using data generated from NMCSD, an inventory management system utilizing economic order quantities (EOQ) with joint ordering and random order generation will be evaluated and compared with periodic inventory management.

NMCSD Pharmacy is responsible for filling about 1 million prescriptions each year (research from NMCSD, July 22, 2016). It is surprising that a pharmacy this size still relies heavily on outdated methods of inventory management. Reorders are initiated by visually inspecting each of the 2,300 SKUs daily or may result if there is a prescription for a medication and there is none left on the shelf. There is no reliable electronic or other system that the pharmacy's staff can use to determine the actual on hand inventory of any items.

NMCSD supply workflow is actually very simple. Each day three technicians spend about three hours walking the shelves reordering the medications as needed (Vancheri, 2016). The supply staff has quite a large quantity buffer because their goal day of stock (DOS) is 30 days' worth and place orders five days a week, Monday through Friday, and usually receive their orders the following day (Vancheri, 2016) except when the prime vendor is out of stock or there is a manufacturer back order. If an order cannot be fulfilled by the next business day, it is removed from the order and must be redone (Vancheri, 2016).

The purpose of this paper is to compare a continuous inventory management system with a periodic inventory system. The status quo at NMCSD is a hybrid of the periodic and the visual method of inventory management. This paper will demonstrate the benefits and detriments of each of these inventory systems.

BACKGROUND

Running a military outpatient pharmacy has many similarities with managing a community pharmacy such as Walgreens or CVS. They both have patients in need of medications and customers expect that, in a short amount of time they can go home with medications in hand. Due to the fact that medications play a significant role in public health, consumers and health care professionals view a stock outage as an incredibly negative experience. To prevent this, pharmacies must have a high service level on all of their items to prevent such stock outages. However, medications or inventory in pharmacies are the largest asset in pharmacy practice, as much as 75% of a pharmacy's costs can be associated with inventory [4]. The cost of inventory is made even more difficult because there is such a growth in the number of drugs on the market as well as the number of people who need these medications [2].

The corporate goal of a civilian community pharmacy is to make a profit. One way to accomplish this it by not tying up capital in unnecessary inventory. Military pharmacies are different because troop readiness and the overall health of beneficiaries is the top priority, not profit. Despite this proper inventory management should not be ignored.

Acquisition, procurement, carrying, and shortage costs are the four major costs associated with maintaining pharmacy inventory [2]. Acquisition costs can be broken down into: price, utilization, mix and innovation.

The Model

For the purpose of this study, the ABC Analysis will be used to help decide which items to focus on to decide order quantities and reorder points. Additionally, this study uses the VEN system to differentiate between medications. According to this system's nomenclature the "V" refers to vital medicines, the "E" indicates essential medicines and the "N" refers to non-essential medicines. The classification of these medications is highly subjective, but typically the vital medications are those where the cost of a stock out is typically very high. These are medications that can save someone's life, have severe withdrawal side effects or are important to maintain the standard level of care [26]. These are the drugs that must be available at all times. The medications in the "E" category are still vital to have, but are not as critical. They may be rarely used or have substitutes or alternatives that do not degrade patient outcomes. All others are in the "N" category. These are the medications that are nice to have, but can be survived without [26] [10].

The use of ABC and VEN Analyses may not always be the right way to differentiate medications for every pharmacy. The ABC analysis is suited for pharmacies that are trying to reduce inventory costs. The VEN analysis better fits an NGO or country that has significant constraints on their medication budget.

This paper proposes an approach combining these two classification nomenclatures into an ABC-VEN matrix analysis [10]. This is performed by assigning each medication an “A,” “B,” or “C” from the ABC analysis and a “V,” “E,” or “N” resulting in nine groups: “AV,” “AE,” “AN” and so on. These groups are then divided into Category I, II, and III as shown in Table 1 below.

Table 1. ABC-VEN Categorization

Category	ABC-VEN Classification
I	AV, AE, AN, BV, CV
II	BE, BN, CE
III	CN

Category I medications replace group A as the most significant category and will be used to conduct the analysis of this study. Categories II and III replace group B and C of the ABC analysis respectively. As an added benefit, this method breaks Category I medications into five joint ordering groups. This classification opens up the most important category of medications, making it important to track and stock some of the B and C items. This is important because with this model, the acquisition costs are not the sole basis for dividing the medications. The VEN method takes into account the intangible shortage cost to the patient or society if they cannot get the medication immediately.

Inventory Control Systems

Pharmacies have three basic approaches of managing inventory: 1) visually, sometimes referred to as “looking it over,” 2) periodically, or physical inventory, and 3) continuously [2] [14]. With these approaches, there are multiple strategies that can be used to further optimize the ordering such as economic order quantity (EOC) and joint order quantities (JOC). EOC focuses on the ordering of each item individually JOC takes items with a large set-up cost per order and combines them to decrease the overall order cost resulting in significant savings [1][20]. To best utilize these metrics, the holding cost must be determined; for a pharmacy, the average annual holding cost is 20–30% of the value of the inventory [19].

Classifying each medication as vital, essential, or non-essential is completely independent of the ABC analysis. Each pharmacy would divide their formulary based on their own needs and criteria. For the purposes of this study each medication was classified according to four major World Health Organization criteria shown in Table 2 below: 1. Days used in NMCSD, 2) Prevention of serious diseases, 3) Controlled substance, and 4) Missed doses importance.

Table 2. Criteria for VEN Classification

Characteristic of Medication or Target Condition	Vital	Essential	Non-Essential
Demand			
Days used at NMCSD	>260 days	100<days<260	<100 days
Miscelaneous			
Prevents serious Disease	Yes	No	No
Controlled Substance	CII	CIII-IV	CV
Importance of Missed doses	Can't miss	OK	PRN

The number of days used at NMCSD and the controlled substance classification criteria are very objective and require no interpretation. The prevention of serious disease and the importance of missed doses, require knowledge of the medications that they are classifying or the conditions the medications are treating. Dividing each medication into vital, essential, and non-essential medications would be a decision for the Pharmacy and Therapeutics Committee [26] and not a single pharmacist or doctor. However, for this study professional judgments and experiences are used to determine if the medications prevented serious disease or if a missed dose would have serious consequences. The result of this ABC/VEN classification can be seen in Table 3.

Table 3. Results of ABC/VEN Classification

	AV	AE	AN	BV	BE	BN	CV	CE	CN	Total
Category I	102	82	57	96			138			475
Category II					156	174		238		568
Category III									1300	1300
Total	102	82	57	96	156	174	138	238	1300	2343
	241			426			1676			

Category I medications replace A as the most significant category to watch. Category I medications will be used to conduct the rest of the analysis of this study. An added benefit of this method of categorization is it breaks the Category I medications into five joint ordering groups: AV, AE, AN, BV, and CV.

Ordering Costs

The information about the time spent on each activity involved in ordering was determined from email correspondence with the supply officers at NMCSD. Also missing in this analysis was the fixed shipping and handling fee that would be a fixed cost charged per order. This cost was not known by anyone interviewed. The pay of these individuals at NMCSD is based on their rank or GS grade and step and is variable based on the people who fill these positions. The salary breakdown and assumptions can be seen in Table 4.

Table 4. NMCSD Supply Staff Salary Breakdown

Job Type	salary/year	Daily wage	Hourly Wage
GS Pharmacist*	$104,392.00	$417.57	$52.20
GS technician**	$60,533.00	$242.13	$30.27
Military Tech***	$51,768.00	$207.07	$25.88

*Assuming GS13 Step 5, **Assuming GS9 Step 5, ***Assuming E3 >3 years with dependents.

The personnel costs associated with the ordering cost can be broken into three categories and is summarized in Table 5 below using the number of personnel, required labor hours, and costs assumed in this study.

Table 5. Order Cost Breakdown

Task	Number of Techs	Number of Pharmacists	Tech hours required/order	Pharmacist Hours	Cost/order
In-processing of Order	2	0	4	0	$242.13
Walking shelves/Building Order	3	0	3	0	$272.40
Managing Order	2	1	5	2	$407.06
Total:					$921.59

The first task of determining the order cost was deciding what a common order cost is and what is item specific. To guide this analysis, a common cost was any cost that would need to be paid if only one item was ordered. The first common cost is "walking the shelves/building the order" because the supply staff could potentially walk the shelves to build the order and only need one item. Managing the order is a common cost because this cost is fixed.

For the *EOQ* model, *S* is the cost of managing the order plus building the order. To make the scenario a little more realistic, the cost of managing the order for the EOQ method is divided by six. Twelve man-hours for a one-item order is not very realistic, however two man-hours managing an order is a reasonable amount of time. The in-processing of the item for a one-item order is negligible because it would take almost no time to complete. The order cost *S* resulting from the application of this strategy turned out to be $340.24 per order.

The total order cost S^* used in in the joint ordering strategy is a little more complex to derive. No manipulation of the order building or order management cost is necessary. The common cost (*S*) is the same for all five joint order groups and is $679.46 when using the periodic system. If a continuous review system were to be used, this would eliminate the order building cost reducing *S* to $407.06. The item specific cost for each category prorated the cost of in-processing the order. An average order for NMCSD contains approximately 177 different SKUs (Vancheri, 2016). To get the per item in-processing cost the $242.13 in-processing cost was divided by 177 to equal $1.37 per item. For each group, the total number of items in the grouping is multiplied by $1.37 for the total item specific cost for that grouping. For the AV items, the item specific cost is $1.37 multiplied by 102 items or $139.53. This item specific order cost when added to the $679.46 common cost, results in a total order cost S^* of $818.99. The ordering costs for all groups using the continuous system are summarized in Table 6 below.

Order Quantity Determination

To determine which system is best, the overall order cost should be compared across all of the models. In this study *EOQ* and the joint ordering approach each with periodic and continuous review have been compared and their total annual costs are shown in Table 7. The holding cost associated with safety stock will not be included because this is cost is not relevant when deciding if periodic or continuous review is best.

DISCUSSION

Inventory management is not a one size fits all decision that one can make. Sometimes even the optimal solution may not be the right one if constraints are present. The best way to analyze an inventory management policy is to start by deciding what inventory items to focus on. Using an ABC analysis can help differentiate the items that really need to be focused on to save money and time from those that really do not have much impact on total cost. Used alone, the ABC analysis is good for some industries, but in the medical community, the most important medications are not always the ones with the highest demand or cost. Patient safety concerns or accreditation requirements are just two reasons why it may be

important to upgrade a medication categorized as a B or C into a more closely observed status. This study shows that the VEN classification system when used in combination with the ABC analysis may provide a better picture on the inventory items that should be focused on. Once the items to focus on have been decided, the analysis of how much and when to order can be subsequently undertaken: periodic, continuous, or a hybrid system. Using the *EOQ* formula or joint order formula the optimal re-order quantities can be calculated for a decision.

Table 6. Summary of Order Costs at NMCSD, Continuous Review.

Ordering Cost	EOQ	AV	AE	AN	BV	CV
Common (S)	$203.53	$407.06	$407.06	$407.06	$407.06	$407.06
s_{av}		$139.53				
s_{AE}			$112.17			
s_{AN}				$77.97		
s_{BV}					$131.33	
s_{CV}						$190.15
Total (S*)	$203.53	$546.59	$519.23	$485.03	$538.38	$597.21

Table 7. NMCSD Pharmacy Annual Cost Analysis of Category Medications.

	AV		AE		AN	
	EOQ	Joint	EOQ	Joint	EOQ	Joint
Periodic Review						
Holding Cost	$343,950.11	$61,749.90	$219,960.32	$41,431.94	$154,276.32	$34,337.66
Ordering Cost	$343,950.11	$61,749.90	$219,960.32	$41,431.94	$154,276.32	$34,337.66
Total Cost	$687,900.22	$123,499.81	$439,920.63	$82,863.89	$308,552.63	$68,675.33
Continuous Review						
Holding Cost	$266,020.15	$50,446.18	$170,123.15	$33,554.80	$119,321.40	$27,477.96
Ordering Cost	$266,020.15	$50,446.18	$219,960.32	$33,554.80	$119,321.40	$27,477.96
Total	$532,040.30	$100,892.37	$390,083.46	$67,109.60	$238,642.80	$54,955.92
	BV		CV		Total Annual Cost	
	EOQ	Joint	EOQ	Joint	EOQ	Joint
Periodic Review						
Holding Cost	$109,462.93	$17,705.21	$359,327.35	$3,464.21		
Ordering Cost	$109,462.93	$17,705.21	$359,327.35	$19,259.74		
Total Cost	$218,925.87	$35,410.42	$718,654.70	$22,723.95	$2,373,954.06	$333,173.40
Continuous Review						
Holding Cost	$84,661.54	$14,427.62	$277,913.32	$2,725.77		
Ordering Cost	$84,661.54	$14,427.62	$277,913.32	$16,810.01		
Total	$169,323.08	$28,855.24	$555,826.63	$19,535.78	$1,885,916.28	$271,348.92

REFERENCES

References available upon request from the authors.