

# **Managing Inventory Cost and Assuring Medicine Availability: a Case Study of a Pharmacy in Jeddah Saudi Arabia**

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## **Abstract**

Inventory management is one of the essential functions of a company to perform efficiently and effectively. Efficient inventory medicines management in pharmacies require close attention to assure availability of the right drugs in the right quantities, at reasonable prices, and at recognized standards of quality throughout the year without any stock-out periods in between. This paper develops a novel dynamic inventory model through integrating multiple approaches to optimize inventory while minimizing inventory cost and assuring medicines availability. Also, the developed model is able to measure the effectiveness of inventory systems of pharmacies. The case study reviews and analysis a current inventory management method of a local pharmacy in Jeddah, KSA. The findings compared current applied method and developed model. The developed inventory model helps the pharmacy to reduce cost by 14.38% while satisfying 100% service level rate.

## **Keywords**

Pharmacy, r-order point, inventory assurance.

## **1. Introduction**

Inventory management is very important to handle products or goods so as to meet the customers' demand whenever required according to the season or as per requirements of people. There is limited research focuses on developing methods for evaluating inventory management systems. Alsaadi, Almaktoom, And Krishnan (2016) introduced a method to evaluate the reliability of each task of an inventory system, as well as overall reliability of an inventory management system. Almaktoom (2017) a novel, design optimizations model is being developed to most effectively allocate resources and schedule time, giving consideration to the uncertainty associated with inventory movement. Resurreccion and Santos (2012) developed multiobjective prioritization methodologies for inventory system evaluation. Inventory management in the pharmaceutical industry is crucial to meet the fluctuation in demands of not only medicine but medical products and services demanded by patients, hospitals, clinics, etc. The strategies to maintain these products and services are highly effective because of the competition and globalization in the health and medical industry.

Shah (2004) in his article said, "The pharmaceutical industry can be defined as a complex of processes, operations and organisations involved in the discovery, development and manufacture of drugs and medications." This industry is very complicated because of the functions and the methods involved in the manufacturing and handling medicines. Many medical companies have come up with a variety of products and services that are similar in functions, chemical formulas registered under different names and dosages. Every disease has different medicine to which the physician recommends to use when required. For this, the company has to have a set of medicines stacked up in the warehouse after manufacturing it in the excess. The inventory management in the pharmaceuticals help every stakeholder of the company due to the unpredictable demand fluctuations that can arise due to untreatable diseases, seasonal changes that leads to weakening of immune system or other causes. With this come many problems that are associated with managing the inventory system and ensuring if the products are available to meet the needs of the people. There are lots of constraints with the supply chain of the medical products due to the nature of these products and the related industry (Booth, 1999).

This research will focus on the factors that help inventory system to be improved and also look into how optimizing inventory management helps in the availability of the products and services. This research will also

discuss ways that can help ensure management of the products and bring about efficiency and effectiveness of the products and services in the medical industry. The methodology discussed in this paper includes quantitative method of research for the following topic. Use of existing data, mathematical modelling, simulation and other numerical data are required to gather numerical evidence to help us in the research. The literature review of this research will first discuss the inventory management of the pharmaceutical industry. It will then discuss how inventory management can be optimized followed by the discussion on the issue of product availability.

## **1.2 Inventory management of the pharmaceutical industry**

Inventory management has always been an issue in the research as well as application. This has made many researchers opt for various models to be built and to be applied in the real world due to the development in technology and globalization that has changed the nature of supply chain worldwide. Earlier inventory was managed manually, but with introduction of the new techniques in the management science, new applications software and programs were specifically developed for the efficiency in the management of inventory. Inventory of pharmaceutical industry is relatively different than that of others because it requires more persistence and determination than the other products in the market as they are health related. They need more care when stored for the public demand as they are stored for a long time and require certain temperature to be maintained because of the active ingredients involved in the medicines and other medical products and services provided to the health industry. Manufacturing of these products itself is so tedious that managing them also becomes difficult. They are manufactured in large quantities because of their chemical nature and are allotted batches after the manufacturing. Haavik (2000) pointed out that these products have high lead time and can last in the stock for more than weeks or months depending on the distribution of these products. In an article by Roark (2005), purchasing power of the people in the country also determines the sales and stocking of the medicines. Other researchers like Scheneller and Smeltzer (2006) pointed out that the industry itself is highly fragmented and lacks efficiency due to which the costs of maintaining them becomes higher than that of production and the ones generated from the sales. Likewise, Alverson (2003) described the inefficiency of the industry by listing out the problems and challenges that acted as barriers in making the inventory management of pharmaceuticals effective and efficient. Many hospitals and medical companies were not having proper control over the inventory as they lacked skills and adequate resources to manage it.

Moreover, a huge stock of medicines being piled up was also an issue due to the price sensitivity of the industry and also because of the fluctuations of the demand in the medicines. There is a lot of stock outs and frequent disturbance in the workflow of the pharmaceutical system. The main issue in the supply chain of the medicines and related products is the availability of the product and ensuring them becomes difficult probably because of the reasons stated by Lauer (2004) that directs towards the product life cycle, price and expiry of patents. There is a lot of risk involved in the pharmaceutical industry. One needs optimization of the management of inventory of medical products to make sure they are available due to the required emergency and the costs associated with them.

## **1.3 Optimization of inventory management in the pharmaceutical industry**

Optimization is required in every part or section of any and every industry of the market. The optimization of the pharmaceutical industry is highly essential because of the inefficient performance of the respective industry as shown by the research articles of other researchers. Industry of the medicines has to be aware of the inventory management being carried out. For this, the companies ought to have strong research and development to increase the life of medicines and thereby increase profit. Due to the globalization and technological advancements, one needs to keep up with the techniques to store and stack the products and maintain their costs. Different companies have variety of ways to handle it based on the resources and costs they have with them. The distribution of the medicines takes a long time due to very strict regulations and safety administration. Booth (1999) indicated that the logistics costs of these medicines are relatively higher and for this reason many companies have most of the products stacked up as inventory.

Shah (2004) showed that optimization is to be to the existing processes, and according to the strategies that encourage in decision making. For this one should consider the product life – cycle, track important development in the supply chain and most of all concentrate on the manufacturing process to warrant the efficiency of the processes that follow manufacturing like that of supply chain's inventory management and distribution. Manrodt et al. (2008) specified that supply chain and its associated functions can be managed by trying to improve the value of the product by removing a lot of wastes by continuous improvement by never leaving any chance for imperfection. He defined this system as lean as it is more customers – driven, flexible so that it can meet the demands of the fluctuations happening in the medical industry.

It helps in reduction of time, energy, wastes and most importantly; cost which is an important issue to be dealt with in any industry specifically pharmaceuticals that require a high amount of cost in comparison to that of other industries. According to Hartmann and Kachwee (2013), they reported that optimization of inventory management through lean system helps in delivery of the products on time, improve the cycle of the product, and improve the turnover and working capital, faster lead times just by reduction of holding inventory.

### **1.4 Issue of product availability**

The issue of the product availability has been there due to many reasons lately in the pharmaceuticals and medical industry. One of the reasons is probably due to the unpredictable demands that come up with the medicines and medical products. This is due to the prices of the medicines that change in accordance to the fluctuations of the medicines in the market during emergency or other events. Lauer (2004) said that forecasting in the demand also leads to the problem of product availability due to the uncertainty in the options offered in the medicine. It causes delivery issues in the end that is related to the management of inventory. Sometimes, overstocking also led to the problems as this showed lack of inventory management. Lack of substitutes also portrayed the product unavailability in the pharmaceuticals. But the most important issue associated with product availability was the cost that came with maintaining these products and to ensure that they are in the market so that the customers face no problems while ordering their medicine during emergency situations or any other future scenarios. With proper strategy of product availability, one has to improvise the existing techniques or the future techniques that are yet to be implemented in the pharmaceuticals. Other alternatives can be also inculcated to ensure the product availability with maintenance of the costs. The issue of cost should be resolved in relation to the availability of the products.

## **2. Research Methodology**

Research methodology is a careful investigation or inquiry specifically through search for new facts in any branch of knowledge. Collected data will be analyzed to find the relevant answers to the research question. The methodology is considered the backbone of conducting any kind of research. It supports and validates the research and its data to determine the possible solutions to the research questions. It identifies the main problems to be solved. It brings about the questions essential for the research. It also develops the hypotheses and selects the sample groups depending upon the nature of the research. It also describes the methods used in the research in order to collect more data about the topic to find answers about research questions which will support the research and make it realistic. It depicts clear picture of the research rather than portraying vague or unclear assumptions

### **2.1 Service level rate**

An inventory management system is necessary to satisfy customer demand at the right time and in a cost effective manner (Krishnan, Almaktoom, & Udayakumar, 2016). Inventory systems output should be measured and compared with a set of performance measures. To control the performance of an inventory system, the process parameters of pharmacies must be kept within a constant range limit. By doing so, comparisons of target performances and actual performances are possible. Once comparisons are completed, specific identified processes can be targeted in order to improve current inventory system.

By using appropriate set of measures, the inventory system performance can be monitored closely for its performance. Successive improvements can be applied to each stage in the inventory system to determine the impact of improvements. Thus, it is important to identify an effective measure that can reflect inventory system performance and customers' satisfaction simultaneously (Almaktoom et al. 2014). Inventory Service Level (SL) represents the expected probability of not hitting a stock-out. Also SL can be used to identify customers' satisfaction and their calculation is based on the availability of product. To illustrate, SL of pharmacy inventory system can be defined as the probability of having required medicine when needed. Statistically can be expressed as shown in Equation (1).

$$SL = Pr(M^A \leq M^R) \quad (1)$$

$M^A$  : actual number of medicine available

$M^R$  : Required number of medicine

Mathematically, the SL rate of inventory is the total number of medicine needed minus the total number of days product is not available to the total number of days product needed. Equation (2) is used to calculate the service level rate (SL).

$$\begin{aligned}
 & \text{if } M^R \leq M^A \\
 & SL = \left( \frac{M^R - (M^R - M^A)}{M^R} \right) \times 100 \\
 & \text{otherwise} \\
 & SL = 100\%
 \end{aligned} \tag{2}$$

## 2.2 Inventory cost

Cost of inventory is the cost a pharmacy incurs over a certain period of time to store its inventory. It determines how much profit can be made on current inventory. Calculating inventory cost helps to balance inventory expenses. It shows if there is a need to store more or less to keep up with expenses or maintain the same income stream. Mathematically the inventory cost is the total number of product on hand multiply by the product cost per unit. Equation (3) is used to calculate the inventory cost.

$$InC = \sum_{i=1}^I M_i^A \times MC_i \quad i = 1, 2, 3, \dots, etc \tag{3}$$

InC : inventory Cost

$M_i^A$  : Number of medicine i available.

$MC_i$  : Cost of medicine i available.

## 2.3 Calculate the Re - order point

The re-order point took in consideration the annual demand and the lead time. The lead time is the number of days it takes to receive required number of medicine when an order is placed. The reorder point states that an order needs to be placed once required number of medicine fall below a certain amount of units. Furthermore, the reorder point maintains enough stock to satisfy the demand between orders. Figure 1 illustrates how the reorder point is connected with the lead time and the order quantity as a function of time.

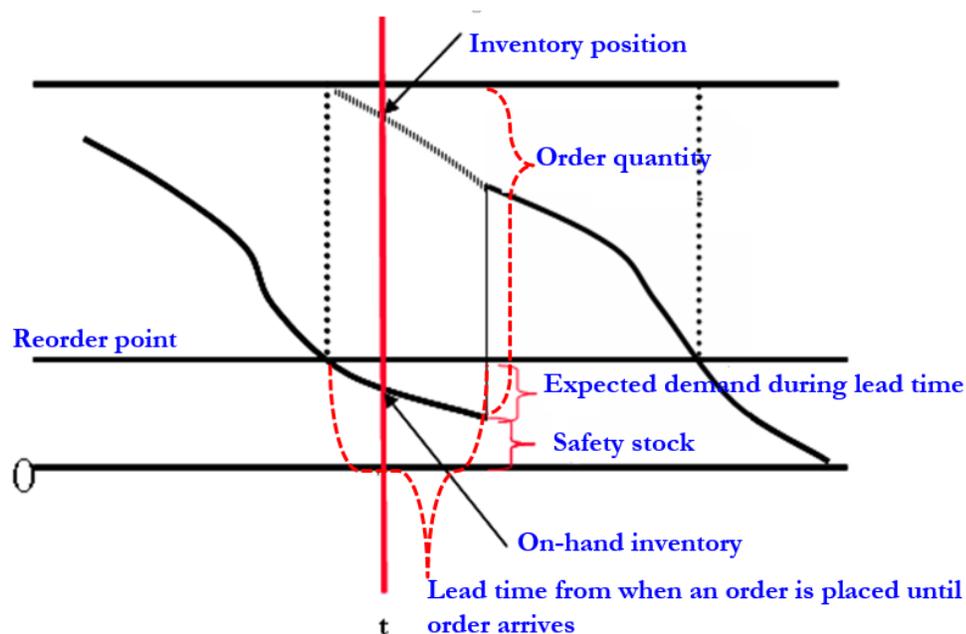


Figure 1. Graph for reorder point and lead time

If the demand is constant and the lead time is known, then the reorder point is written as the Equation (4).

$$r_i = M_i^R \times T_i \quad i \in 1, 2, 3, \dots, etc \quad (4)$$

$r_i$  : Reorder point of medicine i  
 $M_i^R$  : Required number of medicine i.  
 $T_i$  : Lead time of medicine i.

### 3. Case Study

In the recent years the management of pharmacies has become more complicated partly due to the increased demand for drugs as well as the increase in the number and types of drugs they keep as inventory. Therefore, proper inventory management has become the cornerstone of success in the management of pharmacies. The developed method in this research is being applied to local pharmacy in Jeddah, Saudi Arabia. The pharmacy fail to control the stock level. The pharmacy found itself in a situation where it could not provide some drugs since most of them were out of stock. Thus this research aims in improving currant inventory system of the pharmacy to guarantee 100 % service level and minimize inventory cost.

The table below (Table 1) presents data been collected from a pharmacy in Jeddah, Saudi Arabia. Table 1 shows the most 10 selling medical products, order quantity of each products, and lead time.

Table 1. Pharmacy Design Parameter

Best 10 selling product	Selling price in Saudi Riyal (SAR)	Minimum Order quantity	Average time in inventory	Lead Time
panadol extra tab	8.85	Monthly 800	One month	2- days
voltaren gel	9.75	Monthly 650	One month	2-days
adol drops	3.95	Monthly 900	One month	2- days
fevadol syrup	8.05	Monthly 1200	One month	3-days
sapofen syrup	9,85	Monthly 600	One month	2-days
brufen 600 tab	19.95	Weekly 100	One week	2-day
kapect syrup	4.65	Weekly 150	One week	3-days
dompy tab	13.65	Weekly 200	One week	3-days
meva tab	15.60	Weekly 100	One week	3-days
mentex syrup	17.05	Weekly 100	One week	2-days

Table 1 represents information about the highest 10 selling products, selling price, the order quantity (the pharmacy must order fixe amount of quantity to have free product delivery), reorder point (when inventory reach 25%), demand on a daily basis and the lead time. Products cost 70% of the selling cost, An excel spreadsheet were used to sort out the 10 best selling products and calculate their inventory cost and service level rate. The excel spreadsheet would also allow for the organization of data, so that it is possible to establish whether there was an overstock or under stock of the product in the inventory.

#### 3.1 Case Study Results

As a first step is to evaluate the current service level of the pharmacy inventory system using equation (2). This will help the pharmacy reduce stock outs as well as to help them improve customer satisfaction level. For this particular reasons plotting the demand in excel was essential to see the service level for each product as in (figure 3).

Table 2. SL rate for each product

product	Panadol	Voltaren	Adol	Fevadol	Sapofen	Brufen	Kapect	Dompy	Meva	Mentex
SL	100%	100%	100%	100%	100%	86%	73%	73%	76%	90%

As shown in table 2 there were five out of ten products that were consider to be low service level rate. This process was extremely important because it help determined understock inventory. Results of the first stage of analysis shows that the problem particularly lay in the order quantity of the Mentex syrup, Kapect syrup, Dompy tab, Meva tab and Brufen 600 tab. The result was a fall in the stock for these drugs. To ensure that right drugs reach the right people at the right time the pharmacies carry a huge inventory to ensure service level rate close to 100% pharmacy had a huge inventory of drugs such as of the panadol extra tab, voltaren gel, adol drops, fevadol syrup and

sapofen syrup. However, Such a huge inventory increased the pharmacy’s storage costs; also, most of the drugs were perishable, pushing the management to come up with effective inventory management approaches.

One of the things that research identified was that the method used by the pharmacy in calculating the inventory was ineffective in controlling the level of stock in the pharmacy’s inventory. As such, it was proposed that the pharmacy changes its method, and through the recommended inventory model, the pharmacy managed to improve the inventory. Moreover, the recommendation inventory model reduced the cost of the inventory, and helped in improving service level.

The research found out that the pharmacy could face out of stock in their inventory for its weekly order particularly for drugs such as kapect syrup, dompy tablet, Mentex syrup, meva tablet and Brufen tablet. Any stock out would make drugs unavailable, and this would in turn make the company incur losses. If customers came to the pharmacy and found that the drugs they wanted were not there, they would not return. In recommendation model the pharmacy stores more inventory, and this would increase the cost of the inventory. However, it would manage to achieve a target customer service level.

The pharmacy risked overstocking the level of inventory for its monthly order, particularly for durgs such as the panadol extra tablets, Adol drops, sapofen syrup, fevadol syrup and voltaren gel. With overstocking, the company further risked a potentially high cost of inventory. With the recommended method, the pharmacy would achieve positive results, particularly, reduced storage of drugs. The company would have to store fewer inventories so that it would achieve reduced costs of the inventory. By implementing the proposed inventory model, the pharmacy would be in a position to achieve positive results. As shown in table 4 developed inventory model would help the pharmacy to reduce cost of inventory and save approximately 14.38% which adds up to about 78864.8 SAR

Table 3. Optimal re-order point

	<b>Currant reorder point</b>	<b>Optimal reorder point</b>
Panadol extra tab	200	53
Voltaren gel	163	43
Adol drops	225	60
Fevadol syrup	300	120
Sapofen syrup	150	40
Brufen 600 tab	25	29
Kapect syrup	38	64
Dompy tab	50	86
Meva tab	25	43
Mentex syrup	25	29

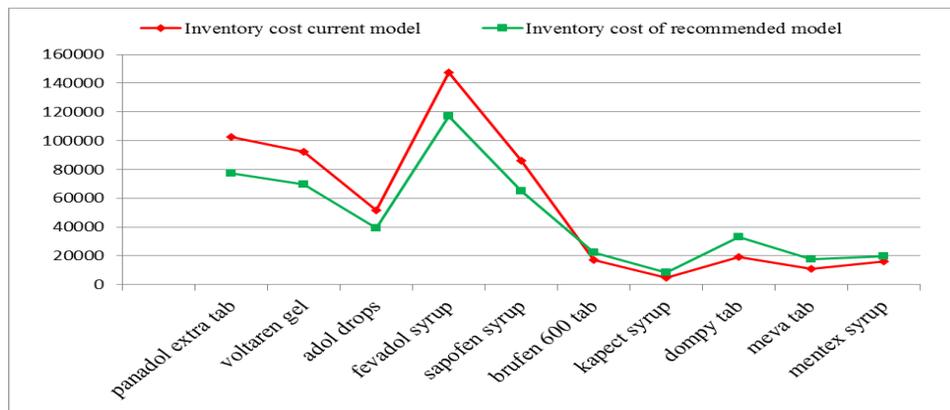


Figure 2. Current inventory cost Vs Optimal inventory cost

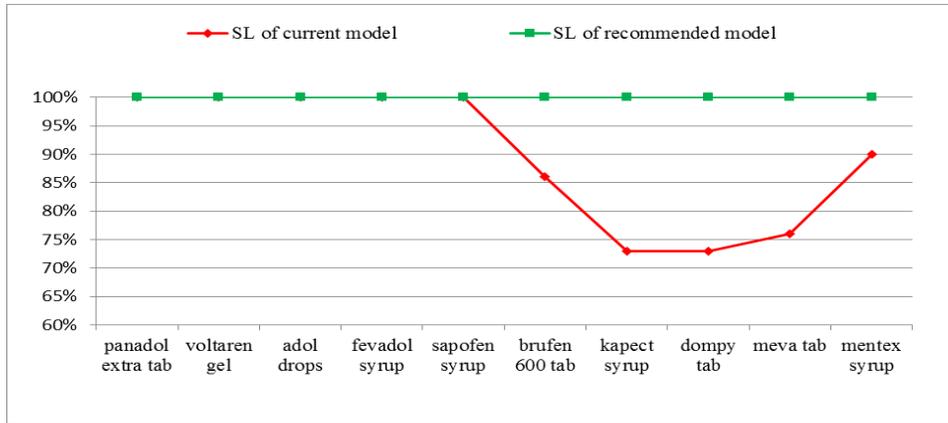


Figure 3. Current design SLVs Optimal design SL

Table 4. Comparison of current method and recommended method

Current total cost	Recommended total cost
548134.3 SAR	469269.5 SAR

Table 5. Comparison of current total cost and recommended total cost

Total saving	78864.8 SAR
Percent%	14.38%

#### 4. Conclusion

Pharmaceutical industry is one such industry where the inventory needs to be managed effectively in order to meet the unpredictable demands of the people. Everything needs to be put in order and stock as the demand is not fixed and it keeps on fluctuating. A part from that, licensing is an issue which the pharmacies need to check every now and then from their stock. This research has helped the pharmacy to understand the importance of maintaining and optimizing the inventory system. Developed approached been applied to a local pharmacy to test its efficacy. Result showed that the pharmacy could save 78864.8 SAR and assure 100% service level rate by optimizing re-order point. This research focused on limited number of drug. Thus authors recommend further study that cover a wide array of other medicines that could have been in the market.

#### Acknowledgements

The completion of this research would not have been possible without the guidance of my supervisor Dr. Abdulaziz. His valuable assistance; advice and encouragement have really helped me. Authors would like to acknowledge Deanship of Graduate Studies and Scientific Research at Effat University for their efforts and support.

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## **Biography**

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