

An Engineering Approach to Improving Hospital Supply Chains

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Summary: Utilizing supply chain best practices from industries outside of healthcare; a supply chain has been designed and modeled that reduces hospital supply chain costs. The supply chain is centered on patient-specific kits delivered from an offsite warehouse to hospital bedsides. Effective implementation requires that each individual hospital segment their products to determine which items are appropriate for the supply chain.



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KEY INSIGHTS

1. Delivery of patient specific customized kits picked at an offsite warehouse and delivered directly to a hospital bedside will reduce healthcare supply chain costs.
2. Products must be segmented in order to determine which items are appropriately held in the offsite warehouse.
3. Successful implementation of the next generation supply chain is heavily dependent upon change management practices.

Introduction

Over the past decade, most hospitals have been facing the challenges of rising costs. For over seven years, the cost of healthcare has been increasing at a much faster rate than inflation. From the year 2000 through 2005, inflation has risen by 18%, while

healthcare premiums increased by 87%. Supply chain management practices are some of the problems driving these continually increasing costs.

It can be argued that as hospitals in the US look to improve margins through revenue enhancement and cost containment, they regard enhancing the hospital's procurement and logistical supply chain as an opportunity to control cost, improve patient safety, and optimize staff time. Hospitals are seeking ways to optimize how they both procure and then move medications and medical supplies through their hospitals in the safest, most cost effective manner. Many hospitals, having for years relied on manual processes, are looking to cutting edge technologies and processes both in and outside of the healthcare arena to choose the best strategy to move forward.

Practices such as hording, over ordering, and leaving inventory management up to nurses within hospitals are some of the factors that have

contributed to the current problems. Nurses horde because of the relationship that exists between the doctors and nurses within hospitals. It is often that nurses are reprimanded when there are stock outs. Over ordering occurs because many of the systems hospitals use to track inventory are manual and outdated. In order to reduce holding costs and stock out occurrences, hospitals may need to update their inventory policies to benefit from the advances made over the past decade in other industries.

The Distributor and Hospitals

In order to probe into the hospital practices, the authors worked closely with HCD, a fortunate 500 medical wholesaler/distributor. HCD has developed several long-term collaborative pharmaceutical and medical/surgical sourcing relationships with hospitals in the United States. HCD provides a vendor managed inventory (VMI) service and stockless inventory arrangement for the pharmaceutical and medical/surgical items they sell. HCD also assists in managing the inpatient pharmacy of these hospitals and installs automatic point of use (APU) systems to manage the local supply of medication and medical surgical products. A key objective of implementation of these systems is to enhance the hospital's procurement and logistical supply chain. The relationship between the hospitals and HCD is viewed by both parties as an opportunity to control cost, improve patient safety, and optimize staff time.

Segmentation

In simple terms, segmentation is to discriminate items into several groups. The homogeneity of the segmented groups allows the standardization of supply chain techniques and reduces the processing costs. Segmentation also helps map the demand and supply channel in a systematic way and lays the foundation for further supply chain optimization.

In order to design supply chains in industries outside of healthcare, a segmentation approach has been successfully taken. Indeed, the complexity and sensitiveness of hospitals would not allow application of these successful approaches directly. To this end, potential segmentation variables are discussed that facilitate applicability to hospitals. Furthermore, the segmentation approach for every hospital may vary and leverage different variables. The following 5 variables are discussed: Criticality,

Unit Price, Demand Level, Demand Frequency, and Demand Dispersion.

Five Segmentation Variables

Criticality - Criticality can be expressed with three attributes: *Danger of Loss of Life*, *Quality of Treatment*, and *Replacement with Other Treatments*. The weights and the grading of these three attributes should be obtained via interviews with medical staff at each individual hospital. Among the hospitals included in this research, the weights are different from one hospital to another. This observation coincides with the need for customized supply chain policies for each hospital. Similarly, the expected service level can be customized to each ward and hospital. Stock-outs for high criticality items should either be measured separately or weighted differently in an aggregate analysis.

Unit Price - Unit price is defined as the value of a drug or medical/surgical item per package. However, the packaging method may vary for items that have different uses and may be used in different frequencies among hospitals. Therefore, packages that have different quantities of the same item are treated as different Store-Keeping-Units (SKUs).

Demand Level - In the hospital, medication demand and medical/surgical-item demand are relatively slow-moving. Figure 1 shows the distribution of demand level. The weekly demands of these items vary drastically, from 5,200 units per week to zero demand during the observation period. Specifically, some of the items have zero-demand but the hospitals must still hold safety stock in order to make sure they are ready for emergency situations. In figure 1, the high-demand items lie only in quadrant 2. The high-demand items are all relatively low value.

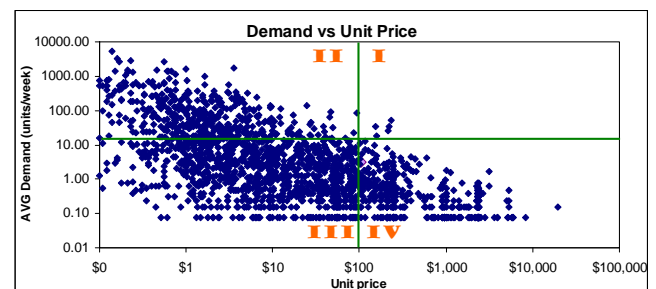


Figure 1: Demand vs Unit Price

Demand Frequency - Demand frequency is the number of transactions over a unit period. A transaction is defined as the action of a nurse or a pharmacist going to the point of use system and attempting to access the items he/she wants, even if the items are not in stock. Figure 2 shows the average weekly number of transactions versus the total average weekly demand of each item. It is clear that there is a group of items with high demand frequencies and with a high demand level. Among these items, the average demand frequencies are above 140 units per week, namely 20 units per day. Relative to other slow-moving items, these items are moving much faster in the hospital. The demand behaviors of these items are similar to *fast moving consumer goods* and can be compared to make an analogy to develop a specific supply chain strategy.

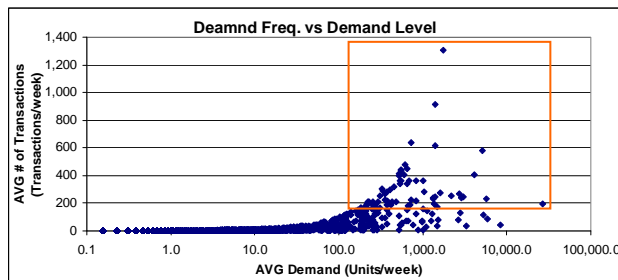


Figure 2: Demand Frequency vs Demand Level

Demand Dispersion - Demand dispersion is interpreted as the number of locations where demand occurs; the larger the number of locations, the higher the demand dispersion. In a hospital, some of the common medication or medical/surgical items are widely used in many wards of the hospital, while some other items are only intensively used in a few specific wards. Whether the demand is fragmented or not can also affect the decision-making process in the supply chain network.

Next Generation Hospital Supply Chain Next Generation Hospital Supply Chain

Once the correct product mix has been determined using appropriate segmentation variables, our model suggests that these items be stored in an offsite warehouse known as a revolver. As many of the different SKUs from each hospital as possible will be stored in the revolver, critical items must be stored within the hospital wards so that the healthcare

professionals have immediate access to these items. Items will be transported from the revolver to the hospital in totes at 20 minute intervals.

The revolutionary idea in the proposed model is that these totes will be filled with product specific to a bed. Nurses and doctors will use electronic handheld devices to place orders that are immediately transmitted to the revolver. The orders will indicate the items that are needed and the bed that the items are for. These items will be processed in the revolver and delivered directly to each bed. The proposed system will reduce the value of inventory hospitals must have on hand, reduce hospital real estate dedicated to inventory storage, reduce the amount of time nurses dedicate to managing inventory and increase revenues derived from hospital beds. Benefits of the next generation hospital supply chain are quantified in table 1.

Category	Savings/(Loss)	Duration of savings
Inventory Value Savings	\$858,564	One-time
Space Savings	\$216,000	One-time
Revenue from Additional Beds	\$250,000	Continuous
Nurse's Time Savings	\$2,651,740	Continuous
Transportation	(\$559,000)	Continuous
Total Annual Savings	\$3,417,304	

Table 1: Annual Cost Savings at NEH upon Implementation of Personalized Kit Supply Chain

Conclusion

This research concludes that implementation of an offsite warehouse in which inventory is pooled would result in savings for hospital supply chains. The savings would be achieved as a result of a dramatic reduction in inventory holding costs, and also a dramatic reduction in on hand inventory. On hand inventory would be reduced because there would be one stocking location instead of multiple locations throughout the hospital. Benefits of the offsite

pooled inventory warehouse would be even greater if several hospitals jointly pooled their inventory in the same offsite warehouse.