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### From Evidence-Based Medicine to Data-Driven Hospital Supply Chains

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#### A Look to The Future

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#### The Challenge of Managing Hospital Supply Chains

Inventory management of medications and supplies within the hospital pharmacy is a complex task. There may be thousands of medications inventoried, the medications have varying shelf lives, and demand changes frequently – daily, even hourly. Medication and supply availability is a critical factor in a hospital's ability to ensure effective, timely, and safe patient outcomes. According to the 2011 American Hospital Association's large-scale survey, the impact of mismanagement extends beyond healthcare costs (due to waste and shortages) to patient care and utilisation of resources. Clinical staff often spend too much time on the inventory and procurement process at the expense of time for patient care. As shown in Table 1, the financial impact of the supply chain is staggering.

Inventory issues are so pervasive that in a survey of 374 U.S. pharmacy directors 75% of respondents indicated they were forced to purchase drugs off-contract from their current vendor, borrow drugs from other institutions, or purchase the drug from an alternative vendor at an increased price when confronted with a drug shortage (Baumer et al. 2004). In addition to the increase in purchasing costs, two-thirds reported delayed or cancelled medical procedures due to drug shortages resulting in an interquartile range of \$33,169,600 - \$300,763,837 in additional costs to the U.S. healthcare system.

In the close to ten years since this survey was conducted, little improvement has occurred in hospitals' ability to respond to drug shortages. Two recent studies identify the same negative impacts associated with drug shortages, further these surveys indicate resources are being allocated and/or diverted away from patient care responsibilities toward the management of drug shortages (McLaughlin et al. 2013). According to the American Hospital Association 2011 Survey, hospitals are interested in taking measures to reduce the impact of drug shortages by increasing inventory and training staff to manage shortages but may lack the guidance regarding how to do this well (American Hospital Association 2011).

#### Towards Continuous Improvement: Embracing the DMAIC (Define, Measure, Analyse, Improve and Control) Process for the Hospital Supply Chain

A challenge in the healthcare environment is to determine ways to develop efficient methods for implementing inventory and supply chain strategies based on characteristics of the "products". While this is not a new concept in other industries, there are unique complexities in managing medications and supplies that provide direct patient care. Unlike other types of products, it is not possible to have a "lost sale" or postpone fulfillment of demand when the product is unavailable without significant consequences to the patient. Despite its unique challenges there is much that can be learned from the advances in supply chain management realised in other industries. In 2001, Virginia Mason Medical Center (Seattle, WA, USA) documented one of the first wide scale applications of lean and six-sigma (LSS) implementations in healthcare. The last decade has brought further awareness and implementation of these methods in healthcare and inventory management is no exception. LSS improvements are data-driven just as the practice of medicine is evidence-based. With the wealth of data captured by technologies such as Automated Dispensing Cabinets (ADCs), there is an opportunity to minimise waste and nonvalue added times by optimising inventory (both in quantity and location).

##### Define:

Identifying the Problem Suboptimal inventory systems cause hospital pharmacies to average a low 10.2 inventory turns per year, lose contract compliance opportunities, and continue costly process inefficiencies (Alverson 2003). In an attempt to improve their drug delivery system, many hospitals have implemented automated systems but have not experienced success due to their labour intensiveness, inefficiencies, and improper inventory management policies (Handfield 2007). An increasing amount of attention and research has recently been focused on developing better management policies and investigating alternative supply chain structures for hospital supplies and medications. The first step is to identify the problem: does your system yield too many medications that expire? Are staff spending too much time locating medications? Are

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there too many stockouts in the ADC? The problem should be articulated in the form of a problem statement as the remainder of the six sigma phases will rely on this. Once the problem is determined, the focus shifts to the measurement phase, which means collecting data.

#### **Measure:**

##### **Taking Advantage of Data**

Data, representative of patient demand, is often captured automatically through the use of barcode scanning and ADC technologies. It is easy to dive into data analysis when it is readily available but a thorough understanding of the current process (using process mapping tools) is critical to put the data into context.

**ANALYSE: Pareto Analysis: The 80/20 Rule and What it Means to Pharmaceutical Inventory** Pareto Analysis is based on the idea that in many settings 80% of problems can be solved by addressing 20% of causes. In the context of inventory management, it means that 80% of drug demand (in terms of volume or spend) is often attributable to only 20% of the drugs. This means that a hospital may make a significant impact on their bottom line by focusing on managing those drugs that are critical to the total spend. Further, it is very likely that the critical drugs will consist of only 20% of the total drug inventory. All drugs do not need to be managed the same way - the potentially overwhelming task of managing the inventory of thousands of drugs may be streamlined by identifying those drugs that are critical and managing this much smaller subset of drugs.

#### **Improve:**

##### **Product Classification Strategies**

Expanding upon traditional ABC analysis (where products are ranked in terms of their total spend and then managed accordingly), researchers and practitioners are attempting to develop more appropriate classification schedules. The ability to classify products, and map these classifications to various types of inventory control and supply chain structures, simplify the management process significantly, especially when there are thousands of products spread throughout multiple locations. Reddy (2008) defined ABC categories for medications as supplies using multiple dimensions beyond cost. An adapted version of this methodology is presented in Vila-Parrish and Ivy (2013) and shown in Table 2.

#### **Control:**

##### **Developing Sustainable Solutions**

Virtual and stockless inventory systems imply that inventories are not kept at a central pharmacy but instead are managed by a supplier and delivered directly to their point-of-use. The objective of these strategies is to enjoy the benefits of Just-in-Time (JIT) inventory management, which results in lower inventory costs. The feasibility of implementing such strategies is highly dependent on the degree of sophistication of the hospital and supplier's information system. Visibility to information such as inventory levels at all stages of the supply chain through electronic data interchanges (EDI) is necessary in order to manage the ordering and fulfilment process efficiently. While this supply chain structure is fairly common in other industries (such as the electronics industry) it has not fully matured in healthcare.

##### **Future of Hospital Supply Chains: Data Driven Decision Making**

There are rich sources of data available to inform more intelligent inventory management strategies. The challenge is to take large quantities of transactional data and transform them into useable information in order to understand and predict demand patterns and behaviours. Further, it is necessary to establish performance measures for the supply chain, including inventory metrics. By instituting a culture of regular reviews you will enable the potential for continuous improvement. A true understanding of the process of order fulfilment is required to develop processes that are lean and proactive – not reactive. With data available at your fingertips the question is not “what data?” but “how do we use this data for decision making?”

Many considerations should be made in this analysis: What is the current versus desired restocking policy? How many local versus global stockouts have occurred and what was the root cause? Are there alternative stocking strategies that may be employed, e.g., is a stockless system feasible? The key to developing a robust hospital supply chain is to utilise the vast amounts of data available to answer questions like those posed above in order to develop responsive pharmaceutical and medical supply inventory management systems. It is time to go beyond using patient data simply for census planning and instead, apply this information to better predict demand for drug and supply management.

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