The Supply of Medical Equipment and Medicines from the Manufacturers to the Military Clinics and Distribution to the End Consumers in the Military Units

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Abstract

The healthcare industry is largely based on decentralized supply chains, where quality and safety remain the cornerstones in delivering effective patient care. A controlled supply of medical equipment and medicines are essential in improving healthcare performance (Dobrzykowski, Deilami, Hong, & Kim, 2014). Similarly, within the military, the efficient procurement of medical supplies, their storage and their distribution to end units for the use in medical treatments of military personnel are critical functions in ensuring the health and well being of the men and women serving in the military. In Israel, where conscription to the military is compulsory for most young men and women, and where military personnel numbers 169,500 men and women, caring for the medical needs of personnel in the military is a complex task (International Institute for Strategic Studies, 2019). This study will examine the supply of medical equipment and medicines, from their initial procurement until they are distributed for use in the small unit clinics in the field. The study will focus in depth on the challenges involved in ensuring a proper and effective supply of inventory to the military units. Although the study mainly addresses the management of medical inventory in the Israeli and U.S. military, the findings from the study provide a framework for dealing with inventory of medical equipment, medicines, and medical kits within most military systems.

Key words: Inventory, procurement, medical equipment, medicines

1. Introduction

Medical inventory which includes medical equipment, medicines, and medical kits is vital for the smooth functioning of military operations, both in regular times and during emergency situations, to maintain the readiness and operational competence of the military units to deal with every medical situation. The management of medical inventory poses its own set of challenges, including dealing with issues of short expiration dates and the need to regularly replace medical kits. The different aspects of managing medical inventory within the military are relevant globally as each military system attempts to develop the most efficient system for the procurement of medical equipment and medicines from the manufacturers and its supply to the military clinics for distribution to the end consumer.

Similar practices are encountered in the management of medical inventory in hospitals within the healthcare environment and much research has been conducted in hospitals worldwide, which may be applicable to the operations involving medical inventory in the military. Volland, Fügener, Schoenfelder, & O.Brunner (2017) determined three categories in their review that are relevant for medical materials until they are used in the hospital. The first, supply and procurement, relates to the purchasing of the materials and encompasses all activities regarding hospital-supplier interaction. The second category involves inventory management. Inventory management includes inventory policy, inventory classification schemes and location planning. Finally, the materials undergo distribution and scheduling (Volland, Fügener, Schoenfelder, & O.Brunner, 2017). In the literature review section, inventory is
defined and publications relating to supply and procurement, inventory management and distribution of medical equipment and medicines are examined.

2. Literature Review

Inventory
Inventory relates to the available materials and goods owned by an enterprise and kept on hand, that are used for its ongoing organizational activity. Inventory has often been divided into several main types. The first type is the finished product inventory, which is inventory whose manufacturing process has been completed and it is ready for use or sale. Work in Progress (WIP) inventory is another type of inventory that relates to items in production by a manufacturer which are at an intermediate stage on the assembly line. This type of inventory may include raw materials or components, labor, overhead and even packing materials. Raw materials inventory for manufacturers includes the raw products from which the final product is made or produced. In addition, packing and packaging materials inventory is the inventory relating to the packaging in which the product is packaged. A certain level of inventory is often maintained to avoid possible delays in awaiting shipment of materials, and thus, coordination of inventory is necessary to ensure that the inventory fulfills the needs of the organization, with effective, productive, and efficient management of the inventory (Zimmer, 2020). Several factors influence an organization’s management of their inventory. These factors include the organization’s purchasing policies, which address available budget and the levels of safety stock. The capacity of the warehouses that stock the inventory are another factor influencing inventory decisions. The characteristics of the supplies themselves, like their shelf-life, further determine decision-making regarding inventory (Buschiazzo, Mula, & Campuzano-Bolarin, 2020).

Supply and Procurement
The attempt to control costs and prevent the stockpiling of inventory involves close monitoring of the purchases of medical equipment, medicines, and medical kits. Volland, Fügener, Schoenfelder, & O.Brunner (2017) examined the bundling of purchasing volumes by healthcare organizations in their efforts to increase their purchasing power. Another strategy addressed in the review is the outsourcing of stock under the framework of vendor managed inventory. Several studies have been published in the literature about the use of vendor managed inventory in the healthcare setting in Canada, Greece and Malaysia, but few studies have addressed the use of consignment agreements in purchasing, although consignments seemingly offer an additional strategy for ensuring supply (Volland, Fügener, Schoenfelder, & O.Brunner, 2017). Furthermore, in healthcare systems, there have been attempts to focus on demand forecasting, which has been challenged by the unpredictability of demand in hospitals, making purchasing based on demand forecasting complex.

Inventory Management
Inventory management covers a wide range of topics, including policies controlling inventory, inventory classification schemes, the planning of locations for storing inventory and others. Appropriate managing of inventory in the healthcare setting has been shown to be a key driver for improving efficiency without being detrimental to patient care (Volland, Fügener, Schoenfelder, & O.Brunner, 2017).

Despite an interest in predicting demand, inventory management in the healthcare setting poses unique challenges for establishing demand and inventory policies take into consideration the unpredictable demand observed in hospitals. To date, much of the research has focused on materials with predictable demand by the hospitals and that experience high turnover, with only limited research being conducted focusing on medical supplies with low and unpredictable demand, amongst these being the
case study in an individual Care Unit (Kelle, Woosley, & Schneider, 2012) and another in an intensive care unit in a hospital in Ireland (Little, & Coughlan, 2008).

In Buschiazza, Mula, & Campuzano-Bolarin’s (2020) study, the researchers focused on the optimization of the inventory management of healthcare supplies in a highly specialized medical institution where heart surgery is performed. They suggested a simulation model that addressed the complexities involved in the management of healthcare supplies. Important aspects that were considered in designing the simulation model included the required service levels for providing patient care, with consideration of purchasing costs, costs involved in maintaining inventory, as well as costs incurred during stockouts. The results from the simulation showed that the purchasing plan was successful in meeting the demand for medical supplies needed for the heart surgery (Buschiazza, Mula, & Campuzano-Bolarin, 2020).

The difficulties relating to inventory accumulation and product obsolescence are more acute in the healthcare setting than in most other settings and may be a major cause of high inventory costs that are observed in hospitals. Yet, opportunities to control inventory costs are not always easy to identify. In a proposed seven-dimensional inventory review framework, seven areas of focus that could influence inventory control were determined. The seven areas were Expiration, Wastage, Unmanned Inventory, Redundancies, Control Deficiencies, Capacity Mismanagement and Knowledge - Skill - Attitude of Manpower. Expiration is when the medical supplies have passed their recommended shelf life. Wastage is caused when more of a supply is used than is necessary for routine care. In certain situations, some inventory is stored in locations which are unmanned and not regularly monitored. Redundancies may be created when supplies are stored in multiple locations and are not always required for effective functioning of the system. In some cases, the processes to control inventory do not effectively prevent misuse or excessive use of supplies. Capacity mismanagement may occur when the design of the infrastructure causes limited availability of the supplies. The knowledge, skill, and attitude of personnel also play an important role in the control of inventory. The lack of knowledge of personnel about the inventory process and the lack of ownership of supplies often contributes to the ineffective control over the inventory.

Thus, these seven areas of focus which are expected to be common to most healthcare inventory environments are aspects that can be addressed when attempting to maintain better inventory control in healthcare settings (Rubigha, 2020).

**Distribution and Scheduling**

Distribution and scheduling is the final stage of the supply process and involves transporting the inventory to its end location (Volland, Fügener, Schoenfelder, & O.Brunner, 2017). In hospitals, the distribution of the medical equipment and medicines usually depends on a multi-level inventory system. With this system in place, the materials are delivered to a central warehouse by the various suppliers. The central warehouse then delivers the needed equipment and medicines to the point-of-use. The point-of-use is considered those locations in the hospital where patient care is delivered. The distribution of medicines must also be controlled by the central pharmacy, which monitors the storage conditions of the medicines and the handling of perishable medications.

In addition to the multi-level inventory system, Volland, Fügener, Schoenfelder, & O.Brunner (2017) reviewed two additional methods of distribution utilized in hospitals. The semi-direct delivery method used in the hospitals incorporated direct delivery methods from the supplier to the point-of-use location. In this method, delivery to the central warehouse was eliminated. In a similar manner to the semi-direct delivery method, the direct delivery method, involves direct delivery by the suppliers to the point-of-use location. However, in the direct delivery process, the suppliers take responsibility for maintaining the required levels of supply needed for patient care at the point-of-use location (Volland, Fügener, Schoenfelder, & O.Brunner, 2017).
Financial Management

Inventory is a crucial factor in an organization's financial activity and impacts an organization control of finances and profits and losses, with the value of inventory an important element within the framework of the organization's financial management. Following the purchasing of the inventory, additional costs are incurred from holding the inventory. These costs originate from the interest that must be paid on the price of the inventory, the expenses in holding the inventory occupying the required storage space and several other expenses.

3. Findings

Several studies have been conducted relating to medical supplies in the healthcare settings. Most of the studies have focused on the hospital environment. In hospitals, after the costs involved in personnel, logistic-related costs, which include material-related logistic costs, are the second largest cost inflicted on the hospital (Volland, Fügener, Schoenfelder, & O.Brunner, 2017). Addressing the management of medical supplies in the military has taken on similar importance to inventory management in hospitals due to the high costs involved in maintaining the inventory of medical equipment and medicines in the military.

Medical Inventory in the U.S. Military

The United States (U.S.) maintains one of the largest militaries in the world. Within the U.S. military, the Defense Logistics Agency (DLA) manages the logistics for the Department of Defense and the U.S. military forces. The DLA has control over five million items, amongst them the medical supplies and equipment required for use in the U.S. military hospitals and clinics. The inventory levels are partly determined by Department of Defense policies, which regulate the quantities of inventory and the frequency of orders, which are further adjusted according to supply and demand. Consideration is also given to holding costs and inspection is carried out of procurement lead times (Haraburda, 2016). The DLA operates globally maintaining distribution centers in strategically placed locations. The strategy for maintaining supplies in the military warehouses ensures that the supplies are available to military personnel as the need arises. When supplies are available close to where they are needed, wait times are reduced and the readiness of the military improves (DLA, 2020).

The DLA is responsible for the supplies provided to medical clinics in the U.S. and in military bases abroad. DLA Troop Support located in Philadelphia, Pennsylvania, U.S.A. manages the medical supplies and equipment needed by the military, including medicines. The DLA Distribution Headquarters are located in New Cumberland, Pennsylvania, U.S. The medical supplies distributed support the critical medical and pharmaceutical needs of the military personnel. These supplies include medical equipment for clinics and field hospitals, surgical items, vaccines, etc. (DLA, 2020). On a regular basis, the medical facilities require medical supplies to be supplied reliably and in a timely manner. The system also needs to respond immediately with additional supplies in emergencies, such as in the outbreak of war or following a natural disaster. In the last few years, the military has been able to ensure that the time frame for supply delivery in the U.S. is one day, while deliveries of supplies abroad can be fulfilled within 5-7 days. Furthermore, 91% of the requests for supplies are met (National Academies of Sciences, Engineering, and Medicine, 2016).

Within the DLA, the Readiness Division ascertains that contracts are in place to meet the demands of the military and its deployed forces. The interest of the division is to maintain a state of readiness at minimal cost. Contingency contracts with manufacturers and distributors enable access to the medical supplies without a need to purchase the supplies in advance. In the case of an emergency, like a war, manufacturers and distributors can use commercial inventories to ensure immediate supply. Thus, when not in use, the supplies can be distributed and rotated in the commercial markets to prevent reaching the
expiration date. The Vendor Managed Inventory (VMI) is one of the contingency contract tools in use by the military. The VMI contract usually involves a long-term partnership with the chosen distributor. The contract ensures that the military has guaranteed access to the required quantities of medical supplies when needed and that these supplies are readily available (DLA, 2020).

Data from 2010, showed that the Department of Defense spent approximately $4.7 billion on the procurement of the medical equipment used in the military. This purchase of medical equipment accounted for just over 1% of the total procurement that was facilitated by the U.S. military (Resnick, Welser, & Yoho, 2014).

**Medical Inventory in the Israeli Military**

In Israel, in December 1947, prior to the establishment of the State of Israel, a central purchasing committee was established to carry out the purchases and orders for the Israeli Defense Force (IDF). The committee collaborated with the military supplies department to determine purchasing needs. At a later stage, the responsibility for logistics was transferred to the Technological and Logistics Directorate. The IDF is currently responsible for determining the needs of the military and for preparing the procurement papers for the Ministry of Defense. The Ministry of Defense deals with choosing suppliers, the procurement of equipment and supplies, managing the orders, budgetary control with payment to the suppliers facilitated by the Finance department (Kagan, Setter, Shefi, & Tishler, 2009). The economies of scale resulting from the bundling of purchases under a central Directorate is expected to lead to cuts in costs similarly to the results obtained in hospital systems that adopted comparable strategies and bundled their purchases by forming voluntary alliances (Volland, Fügener, Schoenfelder, & O.Brunner, 2017).

**Supply and Procurement**

The Israeli Ministry of Defense begins the procurement by signing a contract for supplies with the supplier, fixing the price agreement for the supplies. Once the supplies have been procured, the IDF receives the supplies and equipment and is responsible for managing inventory. In certain cases, the supplies are stored by the supplier and a system of open withdrawals enables the military units to withdraw their supplies from the supplier only once they are needed. Using a system of open withdrawals from the suppliers, the items included in the contract are available to be withdrawn by the army units at any time. This method of ensuring supplies saves the military supply and holding costs, while ensuring sufficient supplies as needed by the units. A large part of the responsibility for managing inventory is thus transferred to the units (Tachnai, 2017). Volland, Fügener, Schoenfelder, & O.Brunner (2017) examined similar strategies that had been adopted by hospitals, where the vendors managed the hospitals’ inventory until it was needed for use by the departments in the hospital.

The purchasing costs of medical equipment and medicines are included within the overall military purchasing expenses. In Israel, customs must be paid on all imported inventories. Thus, there is a guarantee warehouse for this purpose, which is a customs licensing warehouse where a quantity of goods is stored that will be paid for only after the inventory is released for distribution.

**Inventory Management**

To improve supply and to restructure the management of inventory, the Ministry of Defense in Israel has planned the construction of three IDF supply centers over the next few years. All current IDF logistic centers will then be consolidated into the three centers, which will be situated in the north, center and south of Israel to serve the needs in each region (Lieberman, 2020).

Within the Israeli military, the inventory manager is usually a warehouse manager. Several tools are at his disposal for inventory management and include storage and moving tools to assist with the storage process, such as a forklift, packaging tools, signage, etc. In addition, computerized management and information systems also assist in the management of inventory (Kagan, Setter, Shefi, & Tishler, 2009). Generally, SAP software is used on the computers for recording all inbound and outbound inventory in the warehouses. Accurate real-time recording of operations enables the
maintenance of up-to-date information about each inventory item. Nevertheless, inventory management can be impacted by inaccuracies between what is listed in the clinics and the actual inventory in storage.

Having accurate information available about inventory status assists in ensuring efficient distribution of inventory and prevents shortages and out-of-stock events. Furthermore, some medicines require refrigeration or other optimal conditions for storage. Coordination between all military personnel, from the lower ranked medics and clinic supervisors to the higher ranks, like the Warehouse General Staff and the doctors is necessary for monitoring and controlling medical inventory. Also, skilled warehouse managers are needed to manage the inventory in a manner that saves space and storage costs.

In the military, additional challenges increase the difficulties in managing inventory efficiently, especially in the military units’ medical clinics. Frequent personnel turnover, and the need to focus efforts on dealing with medical issues, makes the preoccupation with inventory management in the units’ clinics challenging. These challenges are constantly being addressed at the higher levels of management. The logistics division, for their part, has invested time and efforts in simplifying logistic processes in the medical clinics in the units to enable easier management of inventory.

Inventory Distribution
An effective system of logistics is needed in the Israeli military to ensure that inventory stored in warehouses is available for use when needed in the end unit. To fulfill these needs, transportation systems are in place to move inventory from the logistic centers to local warehouses and computerized systems are used to control the management of the transportation of equipment and supplies (Tachnai, 2017).

Regulations
As in any healthcare setting, regulations exist to control the storage and use of medicines. The Pharmacists Ordinance requires computerized communication processes for the management of medicines. Additional regulations are in place and enforced to control inventory management. In the military, a system has been put in place whereby inventory monitoring is not always necessary for specific items that are not required by regulations to be monitored. These items are recognized as items not being monitored. Some of the changes to the system have related specifically to perishable items, like syringes, needles, bandages, laboratory products, etc. Thus, within the units’ medical clinics, a record does not have to be managed for each of these small items that is withdrawn and used. Limiting the need to monitor every small item in the units’ clinics saves time for the medical personnel.

4. Conclusion

In this study, the supply of medical equipment and medicines from the manufacturers to the medical clinics and their distribution to the end consumers in the military units have been addressed. While managing the supply of medical equipment and medicines within the military has many similarities to managing the supply of medical equipment and medicines in the healthcare setting and most especially in the hospitals, several differences between the systems were noted.

In Israel, the Ministry of Defense deals with the procurement of supplies for the military and thereafter, the Israel Defense Force takes over the responsibility for receiving the supplies, for their distribution and for managing inventory. In the U.S. military, the logistics for the Department of Defense and the U.S. military forces are also centralized and are under the control of the Defense Logistics Agency.

Both in the military and in healthcare organizations, the costs of purchasing medical equipment and medicines constitute a significant portion of the organization’s budget, and thus, steps have been taken to cut purchasing costs and adjust inventories while at the same time maintaining the level of healthcare required. The processes in place for managing the supply of medical equipment and medicines from the manufacturers to the military clinics and the distribution to the military clinics in the units in
Israel normally result in the smooth delivery of healthcare to the military personnel. Nevertheless, as in similar healthcare settings, the Israeli military still faces several challenges with efficiently managing their inventory of medical equipment and medicines, while curtailing costs.

Even though maintaining minimal inventory is expected to lead to cost saving, limited inventory can disrupt the operation of the military medical clinics, when they are unable to meet the medical demands of the operational units. In the military setting, emergencies are not always predictable and thus, determining demand can be challenging. Yet, fulfilling the medical needs of military personnel is always imperative for ensuring full operational competence. When inventory management at the level of the unit clinics is not adequate and inventory is not sufficient, the clinics may encounter problems with the availability of medical equipment and medicines needed for the medical treatment of their military personnel.

Managing inventory that includes medicines and medical kits require special attention to be focused on the expiration dates of the products. Recording of expiration dates into the inventory management system facilitates the efficient monitoring of the inventory and allows for the replacement of medical equipment and medicines when the expiration dates are reached. Inventory that expires while sitting on the shelf, may no longer be used and loses its value. In addition to expiration dates on medicines and medical kits, certain medical devices require the monitoring of periodical competency testing.

Medical inventory management remains a complex challenge both for the healthcare systems and for the military due the importance of providing critical healthcare services, while dealing with high-cost supplies, often with short expiration dates and unpredictable demand. While the numerous studies conducted within healthcare systems, like hospitals, aid in planning for the management of medical equipment and medicines supplies in the military, further research is required that focuses on the specific needs of managing medical inventory in the military to fulfill the healthcare needs of military personnel.

5. References


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