LOGISTICS AND MANAGEMENT OF MEDICAL SUPPLIES CHAINS IN MILITARY DEPARTMENTS

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ABSTRACT

The management of supplies in the military has drawn on supply chain practices adopted from the commercial sector. Supply chains relate to the network of entities that are interdependent and that directly or indirectly serve the final consumer. Although the utilization of supply chains have been shown to increase efficiency and assist in cutting costs in the commercial sector, the complexity of logistics in the military environment cannot always be paralleled to those of the business environment. Furthermore, in the military, similarly to in the hospital environment, medical supplies must be available, whenever they are needed, to prevent the endangering of lives. While several studies have examined the outcomes of the management of medical supplies in hospitals and healthcare organizations worldwide, limited research has been published that addresses the management of medical supplies in the unique medical environment within the military. Alongside an outline of the challenges faced in managing medical supplies, the article presents some of the systems used for supply chain management in the military across the globe. Ensuring the procurement of sufficient medical supplies and their delivery to the point of consumption is critical in providing vital healthcare services for all men and women serving in the military.

KEYWORDS *logistics, medical supplies, military supply chain.*

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1. INTRODUCTION

In the commercial sector, the goal of an organization is usually to maximize profit. As a result, the organization would likely seek to ensure adequate revenue, while maintaining a balance between the costs extending across their supply chain and the level of service provided. The types of products and services provided and the balance needed to achieve the desired outcomes, would usually determine the supply chain strategy enforced by the organization.

The goals of the medical environments, have led to different management approaches being used to manage inventories. Adoption of effective management strategies for use in the medical environment has been slow and the inefficient administration of resources has often been blamed for the spiraling costs of healthcare around the world. Nevertheless, while a surplus of inventory could be blamed for a waste of resources, a shortage of supplies in the medical environment may disrupt entire systems during life-threatening situations. When relating to the goals of medical supply chains, the focus has been on achieving effectiveness, while maintaining healthcare quality (Kwon, Kim & Martin, 2016).

The goal in the military for managing supplies has not focused on maximizing profits, and supply chain strategies have been adopted accordingly (Peltz, & Robbins, 2012). In the military, the goal of the supply chain has been to fulfill the requirements of the military missions, providing maximum

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supply support, without much emphasis on quarterly earnings (Zanjirani Farahani et al., 2009). These goals have differed from the goals traditionally defined in commercial supply chains where the emphasis has been on ensuring profit and improving their efficiency. The main problem †is concentrate on these military goals and develop more research and implementation in sake of humanitarian missions.

Not much research has been published that focuses specifically on the consumption of medical supplies in the military and on the outcomes of the management of military medical supplies, both in peacetime and during emergencies. To examine some of the unique requirements of medical supply management in the military, a review of the management of medical supplies in hospitals worldwide was conducted, as well as a study of the supply chains currently being used in the military. This paper presents a review on this issue, which demonstrates there are still many challenges and much more should be done in the humanitarian field in medical supplies chains of military.

2. LITERATURE REVIEW

2.1 Managing Supply Chains

A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. By definition "a supply chain consists of physical, informational, financial, and knowledgeable flows whose purpose it is to satisfy end-user requirements with products and service from multiple, linked supplies" (Elmuti, Khoury, Omran & Abou-Zaid, 2013). Supply Chain Management (SCM) includes the management of finances and the flow of material and information across the entire supply chain. SCM involves the planning, integrating, and executing of all activities related to supplies, with the aim of best meeting the goals of the supply chain's stakeholders (Peltz & Robbins, 2012).

2.2 Utilization of Supply Chains in Healthcare

Although the utilization of supply chains in healthcare is widespread, research into the overall organizational effectiveness and impact of supply chain utilization in healthcare has been limited. Supply chains have been utilized in healthcare as part of the evolving strategies of the healthcare organizations, and in attempts to increase profitability and maintain competitive advantage of the organization. In a study conducted in healthcare organizations in the U.S., the participants from the healthcare organizations indicated that implementation of supply chains would be expected to lower costs and reduce cycle times. In addition, supply chains were perceived as offering benefits like improved quality, greater productivity, and overall improved organizational performance. (Elmuti et al., 2013). Of the healthcare organizations in the U.S. that responded to the questionnaire distributed by Elmuti et al. (2013) around 62% of the organizations indicated that they did not have a healthcare SCM program in their organization. Furthermore, less than 37% of the organizations defined their SCM as mature and/or integrated. The remaining 63% of the organizations defined their supply chain as immature, due to a multitude of factors like limited cooperation between departments within the organization and with external vendors, as well as a loosely defined structure (Elmuti et al., 2013).

2.3 Supply Management in Hospitals

Inventory management in hospitals has traditionally taken on a centralized approach, as the need for collaboration between decentralized supply chains became imperative in the effort to maintain costs (Dobrzykowski, Deilami, Hong & Kim, 2014).

Bhakoo and Choi's (2013) investigation of inter-organizational systems in the healthcare industry focused on organizations in Australia. In Australia, unlike in the U.S., a three-tier manufacturer–

distributor–hospital supply chain has maintained its dominance. The hospitals, the manufacturers and the distributors are the organizations found at each of the three tiers (Bhakoo & Choi, 2013). Using this system, one of the hospitals reported that since the implementation of technology, they had "reduced the physical stock in the hospital by $70,000". With an inventory that used to be around $350,000–$380,000, they expected to reduce the inventory by "another $30,000–$40,000". Another hospital reported decreasing the inventory holding by 20% (Bhakoo & Choi, 2013).

Three systems commonly used for the distribution of supplies in hospitals, are described in the literature. Generally, hospitals have been utilizing multi-echelon inventory systems. In these systems, supplies are delivered from the suppliers directly to a central warehouse. The central warehouse then distributes the supplies to locations close to patient care, where they are held and managed by the end locations as point-of-use inventories. A second supply distribution system that has been used is the semi-direct delivery system. In this system, the suppliers delivered directly to the point-of-use locations, bypassing the central warehouse. A third system, which involves direct delivery, requires the supplier to be responsible for responding to patient demand and supplying accordingly to the point-of-use location (Volland, Fügener, Schoenfelder & O.Brunner, 2017).

In Greece, by value, the highest levels of stocks were found in the central warehouses of the Greek hospitals. Although most of the stock of the Greek hospitals was held in the central warehouse, a certain percentage was kept in the medical departments and clinics. It was suggested that the inability to manage stock effectively could stem from the lack of an efficient logistics process and limited availability of a comprehensive management information system (Kafetzidakis & Mihiotis, 2012).

A new law enacted in Greece in 2007 sought to improve the hospitals' procurement process and reduce wastes. The new law determined the integrated procurement process for the hospitals in the Greek National Health System (N.H.S). The intent in implementation of the law was to consolidate the purchasing by the hospitals, leading to economies of scale, ensuring the high quality of products and services, as well as maintaining transparency and fair competition between the suppliers. The consolidation of the tenders for products, equipment and services was expected to save over 500 million Euro annually for the N.H.S. During this process, the N.H.S would deal with 1,144 suppliers, who would be required to supply 11,000 types of drugs and 500,000 different types of medical products used in the hospitals (Kafetzidakis & Mihiotis, 2012).

3. FINDINGS

3.1 Challenges in Adopting Supply Chain Management Practices

Research has shown that managing supply chains for medical supplies encounters challenges specific to the healthcare environment. Firstly, forecasting in healthcare is complex, and since the patient mix is unpredictable, accurate forecasting of patient demand is difficult. Fully adopting acceptable supply chain management practices from those utilized for commercial supply chains, has been complicated since stock-outs of inventory in healthcare could be detrimental to the patients' health (Volland, Fügener, Schoenfelder & O.Brunner, 2017).

Furthermore, regulations applicable to medical supply chains are likely to be strictly regulated and different to those relating to the commercial supply chains, which would likely be less regulated (Kwon, Kim & Martin, 2016). While the quality of supply chain operations are important for commercial supply chains, the quality of healthcare supply chains is critical, since the supplies are vital for preserving life (Kwon, Kim & Martin, 2016). The goal of the medical supply chain has been to create the capability to deliver efficiently the materials and information needed to ensure that patients receive quality health care (Elmuti et al., 2013). A study of gains from the utilization of an effective supply chain in the health care industry as compared to those in the manufacturing industry has shown that the health care industry has lagged behind the manufacturing industry in effectively utilizing the benefits inherent in a supply chain (Elmuti et al., 2013).

While approaches to management of medical supplies contend with the requirements of providing medical supplies, healthcare has grappled with containing costs. It has been shown that increasing efficiencies in health care supply chain management has been considered as one of the main tools for controlling healthcare costs while maintaining the quality of health care in the U.S. (Elmuti et al., 2013)

Since sufficient and accurate medical supplies are necessary to cover the varying needs of patients and are critical to patient health, the costs involved in maintaining adequate supplies in the healthcare environment is considered one of the main differences between industrial supply chains and hospital supply chains. Hospitals require thousands of types of supplies and equipment, with much of the medical equipment being of high value and frequently requiring special handling. Furthermore, healthcare supplies change frequently due to newer technology and innovations, increasing the reliability on knowledge and information for efficient supply chain management. These factors create a complex management environment for hospital supply chains, which have become more dependent on knowledge than the traditional supply chains in industry (Chen, Preston & Xia, 2013).

Medical supplies at the hospitals include a wide range of physical goods, used in the treatment of patients. The majority of the supply costs, approximately 70% to 80% of the costs, are channeled towards pharmaceuticals, while the remaining 20% to 25% of the costs relate to medical-surgical materials (Volland, Fügener, Schoenfelder & O.Brunner, 2017).

Inventory utilization rate has been used as a measure for assessing the effectiveness of supply chain management. Several indications have shown suboptimal utilization of inventory in the healthcare environment. Studies have shown that utilization rate of inventory in healthcare stands at only 60–70% of the total capacity (Kwon, Kim & Martin, 2016). Another measure, inventory turns, a ratio used to indicate how many times inventory has been used and replaced within a defined period, has been found to be only 2 in healthcare, whereas in the automobile industry inventory turns is 10 and reaches 44 inventory turns annually in consumer electronics. It has also been suggested that as the level of development of the supply chain increases and with the resulting growth, revenues have been expected to increase as costs decrease. An improvement in patient quality has been noted as the positive by-product of these changes (Kwon, Kim & Martin, 2016). In relation to inventory costs, it has been estimated that based on existing research, inventory costs make up 10% to 18% of the hospitals' net revenues (Volland, Fügener, Schoenfelder & O.Brunner, 2017).

Management of supply chains also needs to consider logistics costs. While logistics costs in the retail industry average at about 5% and for the electronics industry drops to only 2%, in healthcare, logistics costs according to one study appeared as high as 38% of the organization's total expenses (Kwon, Kim & Martin, 2016). In the military, the goal is to reduce the overall cost of logistics to minimize the burden on the taxpayers (Haraburda, 2016).

Research has shown that in the countries of the Organization for Economic Co-operation and Development (OECD), logistic activities compromise more than 30% of hospital costs. Similarly to the data available from U.S. hospitals, logistic costs follow close behind the greatest cost for the hospitals, that of personnel. In the healthcare industry, materials management has not been a priority in hospital management, whose main goal was to ensure that the patients were receiving effective treatment. However, with healthcare costs spiraling, logistic costs are being addressed in the effort to manage the rising cost of healthcare. It has been estimated that more efficient management of logistics could lead to eliminating around 50% of the logistics-related costs (Volland, Fügener, Schoenfelder & O.Brunner, 2017)

3.2 Military supply chains

Adopting commercial supply chain approaches for use in military medical facilities or using the supply chain approaches utilized by hospitals has not always provided the appropriate solution for fulfilling the needs of managing medical supplies in the military. Supply chains for military medical

therapy facilities have been required to procure reliable and affordable medical supplies while ensuring the regular delivery of the medical supplies to the medical facilities. Furthermore, the supply chains must be able to ensure provision of critical medical supplies in a speedy manner during emergencies.

3.3 Managing Supplies in the U.S. Military

In the U.S. Military, the Department of Defense (DoD) is responsible for supervising all the agencies related to national security and the military. The annual budget for the DoD in 2006 was approximately $425 billion (Zanjirani et al., 2009). The DoD manages the supply chains. Over the years, changes in strategic planning, fueled by financial pressures, has driven the transformation from logistic-based operational processes to a more SCM oriented approach. The supply chain system of the U.S Department of Defense includes all "government and private-sector organizations, processes, and systems that individually or collectively play a role in planning for, acquiring, maintaining, or delivering material resources for military or other operations conducted in support of the United States national defense interests". Managing the DoD supply chain is a complex process as a result of the enormous quantities of supplies involved.

The DoD supply system has been modeled after the private sector, in that it has been divided into wholesale and retail processes. The wholesale section has been responsible for procurement from manufacturers, developers and suppliers. Supplies and equipment are then stored in distribution warehouses. These warehouses are located in Integrated Materiel Management Centers, regional supply centers or distribution points (Zanjirani et al., 2009). In 2011, the DoD was maintaining 19 maintenance depots and 25 distribution depots, in addition to approximately 30,000 customer sites. The depots fulfilled the internal wholesale functions, including management of stock and its distribution, while maximizing space utilization and the use of transportation (Haraburda, 2016).

The retail system functioned as a separate entity to the wholesale section. The retail system requested the needed supplies from the wholesale system, with the wholesale system selling the supplies to the retail system. Once purchased from the wholesale system, the retail system then owns and manages their supplies and equipment. These supplies and equipment may be stored at operating locations in the U.S or abroad (Zanjirani et al., 2009).

The supply chain controls more than 4 million stock numbers. To enable the management of such a wide array of items, the supply chain depends on the use of hundreds of logistic management information systems. These information systems deal with thousands of customer activities (Zanjirani et al., 2009).

Most of the military logistics units had been utilizing linear supply chains, based on the existing hierarchical military structures. Under the hierarchical organizational structure, the logistics managers were unable to monitor and control parts of the supply chain found at different hierarchical levels. Since the military units are required to maintain readiness for complex and uncertain environments, the use of the linear supply chain led to a buildup of buffer stock (Haraburda, 2016).

The Defense Logistics Agency's (DLA) Medical Supply Chain provides the support for military treatment facilities both in the U.S. and abroad. Managing the required medical supplies and equipment for the use by the military, is also a responsibility of the DLA. Institutional support for the treatment facilities must ensure reliable and affordable medical supplies regularly provided in a speedy manner. However, during a crisis, operational support is needed to provide the immediate response necessary to meet surge requirements, like the increasing need for supplies following outbreaks of war or natural disasters (National Academies of Sciences, Engineering, and Medicine, 2016).

In 2010, it cost the DoD approximately $4.7 billion for purchase of medical material needed by the military. Medical material compromises just over 1% of the total procurement in the military. In addition, the medical materials procured by the military compromise only a small portion of the

materials manufactured for sale to civilian health care organizations and for public consumption in the U.S (Resnick, Welser & Yoho, 2014).

Improvements in managing the supply chains have resulted in the reduction of inventories, yet it have not led to a reduction in effectiveness. Up until the 1990's, in the military there was heavy investment in stockpiling, which did not prove to be effective. Thus, DLA moved away from warehousing and reorganized its supplies. They reduced inventory from tens of thousands of lines of stock to only 1,100 currently held. In addition, they implemented a JIT model. With these two changes in place, the medical supply chain is able to fulfill 91% of customers' requirements. The expected time frame for delivery of supplies in the U.S. is one day, and for delivery abroad, the expected time frame for delivery may reach 5 to 7 days (National Academies of Sciences, Engineering and Medicine, 2016).

3.4 Maintaining Inventory Levels

Gardner (1987) examined two variables affecting a military distribution system held in the US Naval Supply Centers. These variables included the reordering workload, as well as customer service. The study focused on retail inventories at the supply centers, where each supply center makes its own reorder decisions. Each supply center had in stock approximately 80,000 retail items. The combined value of all the items at each supply center was about $25 million.

The inventory levels of the items were calculated to include safety stock. The role of the safety stock is to minimize the number of requests where items are in short supply. The level of safety stocks depends on variability in demand and lead-time, as well as the required service level. Decisions were made by adjusting order quantities and safety stock to align with constraints inherent in the budget and with the goals determined to provide adequate customer service. Customer service has been defined as "the number of inventory shortages per unit time". The variables that affected the decisions about inventory were variables that reflected the costs involved in ordering and holding inventory, as well as the costs originating in shortages (Gardner, 1987).

At the time of the research, budgetary constraints by law, had determined inventory to be 2.5 months of stock. This was determined by calculating the monthly value of all inventory based on annual demand and multiplying by 2.5. This constraint was inflexible, but within the constraint, flexibility was possible in determining the ratio between safety stocks and cycle stocks. For the calculation of cycle stocks, an estimation of one-half order quantities was used. Generally, while cycle stocks were allocated 1.0 months, safety stocks had been allocated 1.5 months of the 2.5 months (Gardner, 1987). The goal for customer service was to fulfill each customer requisition immediately for the full number of units required. Each supply center was required to be able to supply at least 85% of customer demand immediately from available stock (Gardner, 1987).

Gardner's study showed that at the San Diego Naval Supply Center, when management allocated out of the 2.5 months total investment, 1.0 months in cycle stock, the workload at the supply center was 240,000 reorders per year. When cycle stock was increased to 1.5 months, the workload decreased to 184,000 reorders (Figure 1). In spite of these changes, the customer service measure was almost unchanged (Gardner, 1987).

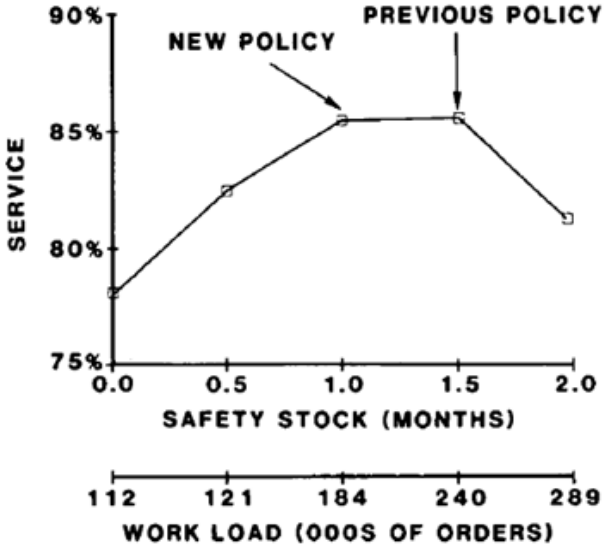

Figure 1: Trade-offs between Work Load and Service with a Fixed-Inventory Investment (Gardner, 1987)

Source: Author, adapted after Gardner (1987)

At each of the supply centers, it was shown that the relative allocation of investment between safety stocks and cycle stocks could be realigned within the 2.5 month allocation, without causing ill effect to customer service. While it was not possible to determine an ideal relative allocation for each supply center, it was suggested that allocation of minimum safety stock should range between 0.8 - 1.1 months of supply. Within these ranges, it was possible to meet the 85% customer service goal, while maintaining the required fixed total investment (Gardner, 1987).

In the supply centers that were examined in the study, the results showed that originally, the total number of reorders for the eight supply centers had been 840,000 reorders annually. While maintaining the fixed investment of 2.5 months stock, the realigning of funds previously invested in safety stocks to cycle stocks in accordance with the specific requirements of each supply center, would result in a decrease in workload to 670,000 orders annually. This amounted to a 20% reduction in the reordering workload. While the reallocation of investments between safety stocks and cycle stocks was not expected to have any negative influence on customer service, it was estimated to lead to $2 million in annual savings on manpower (Gardner, 1987).

The DoD worked with 100,000 suppliers that provided inventory to the value of $92.6 billion in 2015 (Haraburda, 2016). Levels of inventory held by the DoD in the U.S. have been shown to be more than double the amount of inventory that has been deemed necessary to sustain its battle units (Peltz & Robbins, 2012, p. 57).

3.5 Military Supplies in the Israeli Defense Force

In Israel, the Israeli Defense Force (IDF) has been given responsibility for receiving military supplies and equipment and for managing inventory. The Ministry of Defense has dealt with the procurement itself, including the selection of suppliers, the preparation of contracts and the payment to the suppliers through the Finance department (Tachnai, 2017). It has been reported that equipment and supplies worth more than NIS 700 million are purchased by the IDF annually, with medical supplies being purchased through tenders (Tachnai, 2017). The Israeli Defense Force (IDF)

is accountable for providing medical care to enlisted men and women throughout their army service.

For the IDF, the goal of an effective supply chain is to ensure that appropriate resources are in place at the right time and in the amount required. This requires efficient management of resources and the monitoring of inventory. In an attempt to reduce inventory shortages, IDF created a system for open withdrawals from the suppliers. Once a contract had been signed between a supplier and the Ministry of Defense, a list is created of items that can be withdrawn from the supplier at any time. The price agreement is fixed in advance, so that there remains no further need for price quotations. The advantage of the system is that each army unit can manage its own inventory itself, thus saving storage and supply costs and enabling greater control of inventory at the level of the army unit (Tachnai, 2017).

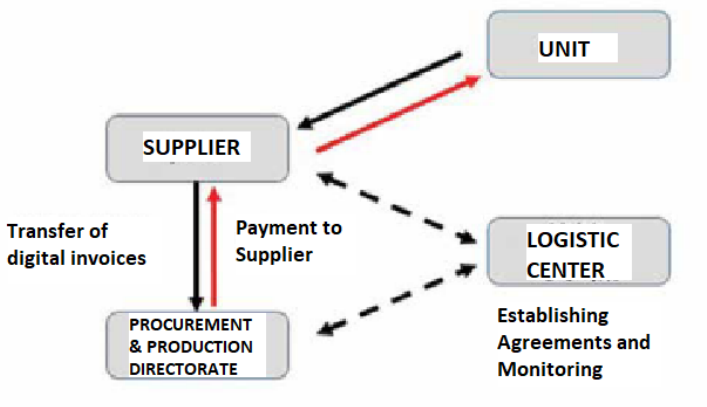

Figure 2: The Ordering & Supply Process in the Catalogue Purchasing Dept. (Translated, Tachnai, 2017)

Source: Author, adapted after Tachnai (2017)

Procurement in the IDF plays an important role with one of the most common methods of purchasing employed being based on the Just in Time practices. Just in Time was a methodology adopted by Toyota, the car manufacturer, and was introduced as a lean methodology intended to minimize inventory while increasing efficiency. The creation of commitments between the manufacturer and the customer, and between the manufacturer and the supplier, has provided a kind of collateral to the supplier and the customer, which built up trust. Implementation of an information system for managing inventory further assisted in the management of procurement, while creating an effective and orderly system (Tachnai, 2017).

In the IDF, logistics bridge the gap between the inventories, which is usually available in warehouses, and between the final consumers. An extensive transportation system, local warehouses and logistics centers spread out in different locations are used to assist in bridging the gap (Figure 2). Effective logistics is achieved through the management, planning, monitoring and control of the movement and storage of equipment and supplies. Management of logistics requires a flow of information through all touch points along the supply chain. Logistics need to coordinate between materials, people and processes, making complete control difficult. The ability to supply the right product at the right time and place requires coordination between different entities, synchronization of the calculation of quantities, and compliance with timetables. The large number of touch points in the logistic processes has the potential for disruptions, and a mistake at any one phase of the chain could cause the whole process to fail. The lack of control arises from the fact that despite planning and managing the process, there is no guarantee that all stages of the process will stick to plan (Tachnai, 2017).

4. CONCLUSIONS

The preparedness of army units depends on adequate and timely replenishment of medical equipment, in all the clinics and locations where medical care is provided. Stock-outs of medical supplies in the military could be detrimental to the soldiers' health.

With the increasing realization of the effect that inadequate inventory practices have had on the spiraling healthcare costs, civilian hospitals have turned to commercial inventory systems to provide an effective and efficient solution to medical supply chain management in their organizations. However, the unique requirements of the healthcare environment create challenges for the implementation of an efficient and effective medical supply chain based on existing commercial supply chain approaches. These challenges are further compounded when considering the medical environment functioning within the military.

Implementing military logistics practices to fulfill the needs of the medical environment in the military has been difficult. Adaptation of commercial supply chain approaches has not always fulfilled the requirements for managing medical inventories in the military. Nevertheless, the military is accountable for providing medical care to its military service men and women throughout their military service, with the soldiers' health being dependent on the supply of medical products needed both in regular and in emergency situations. To ensure satisfactory healthcare for the soldiers, military health care providers need to be supplied with high quality and adequate quantities of medical material resources in all the locations where medical care is provided. Thus, ensuring effective supply chains for the provision of medical supplies and for the avoidance of stock-outs play an important role in ensuring adequate medical therapy in the military clinics.

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REFERENCES

Bhakoo, V., & Choi, T. (2013). The iron cage exposed: Institutional pressures and heterogeneity across the healthcare supply chain. *Journal of Operations Management*. *31,* p. 432–449.

Chen, D. Q., Preston, D. S., & Xia, W. (2013). Enhancing hospital supply chain performance: A relational view and empirical test. *Journal of Operations Management*. *31,* p. 391–408.

Dobrzykowski, D., Deilami, V. S., Hong, P., & Kim, S. H. (2014). A structured analysis of operations and supply chain management research in healthcare (1982–2011*). Int. J. Production Economics. 147,* p. 514–530.

Elmuti, D., Khoury, G., Omran, O., & Abou-Zaid, A. S. (2013). Challenges and Opportunities of Health Care Supply Chain Management in the United States. *Health Marketing Quarterly*, *30*(2), 128–143.

Gardner, E. (1987). A Top-Down Approach to Modeling US Navy Inventories. *Interfaces. 17*(4). p. 1-7

Haraburda, Col. S. S. (2016*).* Transforming military support processes from Logistics to Supply Chain Management. *Army Sustainment. 48*(2), p. 12-15

Kafetzidakis, I., & Mihiotis, A. (2012) Logistics in the Health Care System: The Case of Greek Hospitals. *International Journal of Business Administration*. *3*(5).

Kwon, I. W. G., Kim, S. H., & Martin, D. G. (2016). Healthcare supply chain management; strategic areas for quality and financial improvement. *Technological Forecasting & Social Change. 113*, p. 422–428.

National Academies of Sciences, Engineering, and Medicine. (2016). The nation's medical countermeasure stockpile: Opportunities to improve the efficiency, effectiveness, and sustainability of the CDC Strategic National Stockpile: Workshop summary. Washington, DC: The National Academies Press. doi: https://10.17226/23532.

Peltz, E., & Robbins, M. (2012). *Integrating the Department of Defense supply chain (RAND Technical Report* 1274-OSD). Retrieved from http://www.rand.org/content/dam/rand/pubs/technical_reports/2012/RAND_TR1274.pdf

Resnick, A. C., Welser, W., & Yoho, K. D. (2014). *Sourcing and Global Distribution of Medical Supplies*. Santa Monica, CA: RAND Corporation.

Tachnai, D. (2017). *The "Bull Whip" Effect*. The Ministry of Defense Publishers, 474-475. p. 60-67 (Hebrew).

Volland, J., Fügener, A., Schoenfelder, J., & O.,Brunner, J. (2017). Material logistics in hospitals: A literature review. *Omega 69*. p.82–101.

Zanjirani Farahani, R., Asgari, N., & Davarzani, H. (2009). Supply Chain and Logistics in National, International and Governmental Environment: Concepts and Models. 10.1007/978-3-7908-2156-7. Springer-Verlag, Berlin Heidelberg