

SUPPLY CHAIN MANAGEMENT: MANAGING THE SUPPLY CHAIN IN PEDIATRIC HEALTHCARE

Brittany L. Hart, MBA Student, University of Central Arkansas, 59950 Isabella Ln, Saint Helens, OR
97051, (708) 925-5569, bhart3@cub.uca.edu

Mark E. McMurtrey, Professor of MIS, MBA Director, University of Central Arkansas, College of
Business 102-H, 201 Donaghey Ave, Conway, AR 72035-0001, (501) 450-5308, markmc@uca.edu

ABSTRACT

Today, supply chain management as the foundation of successful business operations is rapidly advancing in both principle and practice. This, however, has not always been the case, and the prevalence of supply chain management as a prominent organizational strategy is a relatively recent development. The recency of supply chain management's central role is most notable in healthcare, and the extent to which the essentiality of material goods parallels the ability to provide vital services is nearly unmatched by any other industry. Furthermore, the redesign and modern positioning of the healthcare supply chain has created unequal implications for the pediatric segment in particular. This paper aims to examine these implications in conjunction with the broader categories of supply chain management and the healthcare industry, and, as a member of the supply chain at Arkansas Children's Hospital at the time of this writing, it is my goal to both apply and expand my current knowledge surrounding this topic.

INTRODUCTION

Supply Chain Basics

The definitions of supply chain and supply chain management are vast, and a simple search of either term will yield a multitude of descriptors from a diverse range of sources. In an effort to pinpoint these definitions for the purposes of this paper, a supply chain, in its most basic form, is a channel of distribution stretching from raw materials, to parts and components, to the finished goods, products, and services that are received by final buyers. More specifically, supply chains focus on the *processes* that transfer physical material and disseminate information throughout the channel and through the various stages of production and operation, and they are constituted by the group of firms who engage in these processes (Jacobs & Chase, 2016).

Consistent with this train of thought, one definition notes that a supply chain "is the network of organizations that are involved, through upstream (i.e., supply) and downstream (i.e., distribution) linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer" (Mentzer, DeWitt, Keebler, Min, Nix, Smith, & Zacharia, 2001). Expanding upon this definition, Mentzer et al. (2001) describe three levels of supply chain complexity: 1) a *direct supply chain*, which "consists of a company, a supplier, and a customer involved in the upstream and/or downstream flows of products, services, finances, and/or information," 2) an *extended supply chain*, which "includes suppliers of the immediate supplier and customers of the immediate customer, all involved in the upstream and/or downstream flows of products, services, finances, and/or information," and 3) an *ultimate supply chain*, which "includes all the organizations involved in all the upstream and downstream flows of products, services, finances,

and information from the ultimate supplier to the ultimate customer.” It is here that Mentzer et al. (2001) differentiate between supply chain and supply chain management, stating,

[I]t is important to realize that implicit within these definitions is the fact that supply chains exist whether they are managed or not. If none of the organizations actively implement any of the concepts discussed in this paper to manage the supply chain, the supply chain—as a phenomenon of business—still exists. Thus, we draw a definite distinction between supply chains as phenomena that exist in business and the management of those supply chains. The former is simply something that exists, while the latter requires overt management efforts by the organizations within the supply chain.

Therefore, supply chain management (SCM) describes the strategic effort to plan, manage, and coordinate all development, sourcing, procurement, conversion, logistics, and information systems activities in collaboration with suppliers, manufacturers, service providers, buyers, and end users, and is, in essence, an integration of “supply and demand management within and across companies” (Council of Supply Chain Management Professionals, 2016).

The Supply Chain Imperative

As pointed out by SCM professor Robert Handfield (2011), “practically every product that reaches an end user represents the cumulative effort of multiple organizations.” In light of increasing globalization and competitive pressures across all industries, the success of this cumulative effort weighs heavily on the overall success of the organizations involved, and, thus, supply chain management has become an essential organizational function. By limiting inefficiencies and miscommunications both internal and external to the organization, supply chain management “has the ability to maximize customer value and sustain a competitive advantage,” as well as eliminate waste, increase quality, and improve customer satisfaction (Habib, 2015). Through the synchronization and harmonization of supply chain processes, supply chain management enables firms to mitigate the risk of supply chain failure and to gain superior control over costs and resource consumption, both of which are imperative to a firm’s profit margin and to its success in the competitive environment.

HEALTHCARE SUPPLY CHAINS

Evolution of the Healthcare Supply Chain

Relative to the concepts discussed in the introduction, from a historical perspective, the health services sector typically viewed the supply chain as a mere phenomenon of business that performed a necessary, yet uninspiring function. For much of the industry’s history, supplies, materials, and equipment were treated as commodities – not managed as assets – and physician preference often governed their acquisition. Described by one SCM professor and healthcare industry researcher, “By and large, supplies were used as something that had to be there to carry out a procedure,” and “the expectation from the physicians was that what was there is what the clinician wanted” (Jayanthi, 2014). This created a long-standing and pervasive position that the supply chain was in place simply to meet physician expectations and to accommodate individual preferences, which resulted in a highly fragmented and asynchronous supply chain.

Such negligent management of the supply chain was then reinforced by a lack of technological infrastructure. In comparison to the technologically rich history of supply chains in the manufacturing sector, the technological capabilities of healthcare institutions to manage the flow of materials and

information severely lagged behind. Retrospectively, as materials moved downstream from manufacturers to suppliers to hospitals, “the quality and robustness of accompanying management and information systems used to manage these products deteriorated significantly,” and the “technology that provided advanced planning, synchronization, and collaboration upstream at the large supply manufacturers and distributors was rarely used at even the world's larger and more sophisticated hospitals” (Langabeer, 2005).

This outdated approach, however, has deteriorated throughout the past decade in response to dramatic, and often sudden shifts in the healthcare landscape, including a volatile regulatory environment, escalating costs, and economic instability. Thus, the evolution of supply chain management stems from the realization that healthcare institutions can no longer isolate their focus on profits, but rather must focus on the convergence of two seemingly opposing objectives: reducing the cost and improving the quality of healthcare. And, as a result of prolonged mismanagement of the supply chain, the opportunities to do so are tremendous. In fact, a 2008 study conducted by PricewaterhouseCoopers’ Health Research Institute concluded that “the opportunities for eliminating wasteful spending add up to \$1.2 trillion, or more than half of health spending,” and notes that solving these inefficiencies “means developing system-wide incentives to encourage partnerships and networks that work toward shared value.” Furthermore, practical methods to systematically measure healthcare quality have developed alongside the supply chain, increasing the probability of achieving both cost and quality driven goals.

Current State of the Healthcare Supply Chain

As stated by Eugene Schneller (2016), a SCM professor at Arizona State University’s W.P. Carey School of Business and the Director of Health Sector Supply Chain Research Consortium at CAPS Research, “Supply chain management in healthcare is not a new idea, but it’s certainly one whose time has arrived.” Despite this, Schneller (2016) heeds warning, stating, “Make no mistake: A great deal of fragmentation still needs to be wrung out of the system. The continuum of care is under study for efficiencies — from the ambulance through the hospital to the home or post-acute care. There is still unnecessary waste and repetition. As other industries have learned, progress comes from visibility into the ‘end-to-end’ chain of value.”

Such visibility is riddled with difficulties, however, and challenges such as the inability to precisely predict patient demand for medical supplies and services hinders any radical advancements in efficiency. Furthermore, physician preference remains an ongoing issue, and there is a notable reluctance by clinicians to accept standardization practices. Although the SCM focus today is leaps and bounds from merely a decade ago, healthcare’s supply chain costs still account for nearly 40% of total organizational expenditure, compared to two to five percent in other industries, and collaboration among supply chain firms is also noted as lacking (Kim & Kwon, 2015). Therefore, while progress has been made, healthcare supply chain management still lags behind the majority of other industries. To better understand this current state, the remainder of this paper will focus on supply chain management from a hospital perspective.

SUPPLY CHAIN MANAGEMENT IN THE HEALTHCARE INDUSTRY

The Products

While pharmaceuticals and medical devices most easily come to mind, the types of materials the hospital supply chain must procure and manage expand far beyond these two categories. To put the

scope of these goods in perspective, additional categories include, but are in no way limited to: food and beverage (e.g., cafeteria, patient meals), linen (e.g., sheets, scrubs, gowns), environmental services (e.g., cleaning and waste removal), marketing/promotional (e.g., business cards, patient education/information materials, t-shirts, advertisements), IT (e.g., computers, software), vehicles (e.g., patient transport, groundskeeping, courier services), telecommunications (e.g., office, call center, and mobile communication equipment), office supplies (e.g., paper, writing utensils, ink/toner), media services (e.g., conference room equipment, projectors, televisions), maintenance (e.g., electrical, plumbing), gases (e.g. oxygen, nitrogen), appliances (e.g., refrigerators, microwaves, washing machines), and furniture (e.g., office, waiting room). While the product classifications are clearly broad, the remainder of this paper will primarily focus on the pharmaceuticals and medical devices involved in the supply chain.

The People

Manufacturers, Suppliers, and Distributors are members of the supply chain that produce, provide, or furnish goods and services, and are typically responsible for handling, storing, and/or transferring those goods and services. While members may assume only one of these identities (i.e., the supplier supplies raw materials to the manufacturer, who in turn converts the raw materials to a finished product, at which point the product is passed on to the distributor), it is not uncommon for a member to be considered either a combination of two, or all three, of these titles.

The *Purchasing Department* and its *Buyers*, from the hospital perspective, serve as the healthcare organization's procurement service center. The buyers are responsible for maintaining relationships with manufacturers, suppliers, and distributors, enforcing the organization's purchasing policies, ensuring contract compliance and cost assurance, as well as overseeing all aspects of the procurement process, including creating and issuing purchase orders and handling product returns, repairs, and recalls.

Healthcare Providers include the physicians, clinicians, nurses, and other healthcare professionals who engage in product evaluations, submit purchase requisitions, and provide quality assurance feedback to the Purchasing Department and Buyers.

Carriers are the supply chain members who arrange and/or provide for the transport and delivery of material goods from the manufacturers, suppliers, and distributors to the hospital. The use of specific carriers, as well as allocation of shipping costs, is often designated in the contractual agreement between the manufacturers, suppliers, and distributors and the hospital.

The *Receiving Department* is the hospital department responsible for receiving the goods delivered by carriers, and for ensuring that all items received match the shipment's packing slip. Receiving then "receives" the items against the purchase order and delivers the items to the *Goods Receiving Department*, which is the department or unit within the hospital where the health provider who requisitioned the goods, and who is designated as the receiver on the purchase order, is located.

Warehouse, also referred to as *Central Stores*, and the *Internal Supply System* are the supply chain members responsible for storing stocked items (i.e., inventory). In addition, these members deliver inventory items to Goods Receiving Departments, where the items are then stored in a supply closet or automated supply machine in the department's clinical area. Warehouse or Central Stores is often located in a separate facility, apart from the primary hospital, and is responsible for performing the Receiving Department functions for its inventoried items. The Internal Supply System, on the other hand, is typically a smaller version of central stores located within the main hospital, and replenishes

its inventoried items from both the purchase orders received by the Receiving Department, and from the items stored in the Warehouse.

The Processes

Many of the hospital's supply chain processes center on organizational buying, which is "the decision-making process by which formal organizations establish the need for purchased products and services and identify, evaluate, and choose among alternative brands and suppliers" (Kotler & Keller, 2016). One group of activities in the organizational buying process includes the evaluation and introduction of new products, in which the product will typically undergo a thorough value analysis process to ensure contract compliance and to evaluate the cost impact. Based upon the data from this analysis, the product will be further evaluated in terms of potential cost reduction, improved patient outcomes, and increased efficiencies in product utilization.

In addition, the product will be evaluated in regard to quality and patient safety standards. If the product is deemed satisfactory after this process, Purchasing will typically set a trial date, in which the vendor will provide samples so that designated healthcare providers can use and evaluate the product in the clinical setting. At the end of the trial period, the providers will complete evaluation forms and submit them to Purchasing for review. If the product receives positive feedback and the majority of providers are in favor, Purchasing will approve the new product and plan for either the addition of the item, or a conversion if the new product will be replacing a product currently used.

A second activity includes vendor selection, and vendors are commonly evaluated and selected based upon the quality of product offerings, pricing and contract obligations, availability and lead time for delivery, and post-purchase maintenance and support services. Additional activities include product development, in which the hospital may work directly with a manufacturer to develop a customized product, and inventory planning and management, which must accommodate receiving and transferring goods at various levels of an item's packaging string (e.g., order and receive by the case, transfer from Central Stores to Internal Supply by the box, distribute to Receiving Goods Department by the pack, and patient charge by the each).

The Goals

The most basic goal of supply chain management is to coordinate "organizational operations into a systematic approach in order to create value and profit" (Habib, 2015). For a healthcare organization, value and profit creation take the form of quality care and cost savings, which are achieved via the implementation and management of SCM processes that aim to ensure the right products, for the right patients, departments, and inventories, are delivered to the right locations, at the right time, in the right quantity and condition, and at the right cost. Therefore, the primary objective of healthcare supply chain management is to reduce excess costs, whether from inefficiencies, waste, or non-competitive pricing, without negatively impacting—and preferably improving—the quality of goods and, ultimately, the quality of care.

MANAGING THE SUPPLY CHAIN IN PEDIATRIC HEALTHCARE

Pediatric Healthcare

While the differences in age and life stage between them are straightforward, the distinct patient demographics pediatric and adult hospitals each serve, in addition to infrastructure and resource allocation, create preeminent distinctions in how these institutions must approach their operational

systems. Underpinning these distinctions is each sector's relative proportion of the healthcare system, and it is important to note that children's hospitals constitute just 5% of US hospitals (Children's Hospital Association (CHA), 2016). This means that of the roughly 5,600 hospitals in the United States, *less than 300* are children's hospitals (American Hospital Association, 2016). The number of children's versus adult hospital admissions is disproportionate as well, with children and adolescents comprising nearly 20% of all US hospital stays (Owens, Thompson, Elixhauser, & Ryan, 2003). Furthermore, while infants under the age of one account for only 1% of the US population, they comprise 13% of all hospital admissions and 10% of total spend for hospital stays (Owens et al., 2003). Therefore, utilizing just one-twentieth of the US healthcare infrastructure to provide care to one-fifth of the patient population significantly influences a children's hospital's operational strategy, and also more clearly defines the different pressures and demands faced by pediatric and adult care facilities.

Additional research also highlights a disproportion in how children's and adult hospitals are reimbursed for services. In 2003, nearly 40% of all children hospitalized were covered under Medicaid, as opposed to just 17% of program coverage for adults receiving care (Owens et al., 2003). These figures have only increased, and in recent years, children's inpatient, outpatient, and emergency room visits have been paid for by Medicaid at an average rate of 54% (CHA, 2016). For example, according to publicly available audit reporting data, Medicaid and Medicare reimbursements constituted, on average, 67% of Arkansas Children's Hospital's gross patient revenues from 2012 to 2016. Looking at these figures, it becomes excruciatingly clear how vulnerable these institutions are to changes in healthcare law.

Further differences are apparent in the types of health conditions most often experienced by the two patient groups, and just three respiratory disorders — pneumonia, bronchitis, and asthma — “are responsible for nearly \$3 billion in charges or nearly 7 percent of the total U.S. health care bill for children and adolescents” each year, whereas adults suffer primarily from cardiovascular disease and injury (Owens et al., 2003). Discussed further by Owens et al. (2003), “While pneumonia and affective disorders rank in the top 10 for both pediatric and adult hospitalizations, most of the other diagnostic categories do not overlap, demonstrating the unique nature of hospital care for children.”

Furthermore, many of the strategic and operational distinctions between child and adult care stem from differences in how these patient demographics affect an institution's philanthropy and mission. In this regard, the Children's Hospital Association (2016) offers the following narrative to distinguish the area of pediatric medicine from traditional adult care:

The notion of an institution that is focused only on admitting, treating and discharging sick patients is fading. Children's hospitals, by virtue of their expertise, the timing of their interventions early in life, and the reliability of their brand, can potentially impact the health of entire generations. When it comes to healthcare, kids are different. Kids need healthcare focused on their unique needs; care that involves parents from start to finish and is delivered in child-centric, healing environments. Children require extra time, monitoring, specialized medications and specially trained healthcare providers who are compassionate and understand kids of all ages. They also need institutions that champion healthcare practices and policies to continually improve pediatric care, making it affordable and accountable.

Issues and Challenges

Representing such a small fraction of US hospitals, pediatrics is clearly a niche healthcare market. Yet, as a result, children's hospitals serve a broader range of patients, illnesses, and geographies than

most other community hospitals. In fact, children's hospitals perform well over 90% of all pediatric organ transplants, cardiac surgeries, and cancer treatment, and most often serve as regional points of pediatric care (CHA, 2016). This underrepresentation in the market, juxtaposed with the volume and speciality of care, poses a major challenge for children's hospital supply chains in regard to the availability of quality materials. While pediatrics is a niche in the healthcare industry, the development and production of pediatric pharmaceuticals and medical devices is a niche in the manufacturing sector as well, and lack of children's hospital purchasing power, coupled with lower inventory turns and profit margins for manufacturers, has severely limited the number of healthcare vendors willing to bring pediatric goods to market. Even further, the widely produced medications and supplies in the adult segment are most often not compatible with pediatric requirements, and when a lack pediatric alternatives exist, the use of adult products for children turns into a matter of increased risk to patient safety.

Regarding pharmaceuticals in particular, a review published by the American Academy of Pediatrics states, "Children differ from adults in many aspects of pharmacotherapy, including capabilities for drug administration, medicine-related toxicity, and taste preferences. It is essential that pediatric medicines are formulated to best suit a child's age, size, physiologic condition, and treatment requirements. To ensure adequate treatment of all children, different routes of administration, dosage forms, and strengths may be required. Many existing formulations are not suitable for children, which often leads to off-label and unlicensed use of adult medicines" (Ivanovska, Rademaker, Dijk, & Mantel-Teeuwisse, 2014). In addition, the lack of adequate pharmaceuticals often increases the complexity of the supply chain, where children's hospital pharmacies must commonly house their own formularies, in which adult-intended medications must be reformulated and measured in pediatric dosages.

In 2004, the US Department of Health and Human Services presented a report to Congress summarizing the medical community's outcries regarding "the need for pediatric devices in several medical specialties, including pediatric cardiology, pulmonology, nephrology, orthopedics, and surgery," and their concerns regarding "the widespread practice of modifying adult devices for pediatric use, the risks of that practice, and the need for data on long-term effects of device use as well as adverse events in children." Over a decade later, these needs and concerns are still being addressed, and there are several challenges relative to the development of pediatric medical devices. Addressed by Linda Ulrich (2013), Director of the FDA's Pediatric Device Consortia Grant Program, the three primary challenges to pediatric product development include device, trial, and regulatory issues.

According to Ulrich (2013), these three issues are described as: (1) *device issues* resulting from the small size of the pediatric market and the need for multiple sizes to accommodate patients from newborn to young adult; (2) *trial issues* including high cost, enrollment challenges, lack of pediatric trial and research infrastructure, ethical complexities, and the need for consent and cooperation from both the parent and the child; (3) *regulatory issues* that provide poorly defined incentives to manufacturers and suppliers who invest in pediatric product development. As a result, standardization of vendors and supplies is an enormous challenge. To provide an idea of the magnitude of the procurement process for a pediatric institution, the purchasing department at Arkansas Children's Hospital holds roughly 6,000 active suppliers in its vendor dictionary, from which it has purchased over 22,000 *unique* items on regular basis in the past year — and this total does not include purchases for items not registered in the item dictionary, such as books, custom-made/patient-specific orthotic, prosthetic, and surgical items, credit card purchases from vendors who do not accept purchase orders, and certain types of infrequent or one-time-purchase items.

Additional challenges faced by children's hospitals stem from their involvement in local, state, and regional outreach activities. According to the Children's Hospital Association (2016), the average freestanding children's hospital spends \$104.3 million a year on community benefit programs, which include abuse prevention, mental health services, wellness programs, and many others. These types of activities contribute to the expansion of the types of materials a children's hospital must procure, and also increases the complexity of the supply chain by adding numerous offsite delivery locations.

Furthermore, nearly all children's hospitals are nonprofit organizations, which means they operate in the absence of government funding and assistance, and function largely on donated funds. Often governed by missions to never turn a child away regardless of a family's ability pay, children's hospitals also absorb a significant amount expenses. Arkansas Children's Hospital, for example, lost an average of \$11.67 million in revenue per year between 2013 and 2016 to charity care cases, in which it provided free or discounted care for individuals with household incomes up to 400% of poverty levels. Furthermore, Arkansas Children's Hospital allows interest free payments to be made until outstanding balances are paid, without time constraints, and does not report to external collection agencies or take other extraordinary collection efforts.

In addition, 85% of children's hospitals are registered trauma centers, compared to less than 20% of adult hospitals, and emergency trauma services constitute one of the largest sources of uncompensated care for all healthcare institutions (CHA, 2016). Arkansas Children's Hospital, for example, is the only level 1 pediatric trauma center in the state of Arkansas. As a result of these financial constraints, the supply chain has the potential to suffer from a pediatric hospital's ability to acquire supply chain talent, increased pressures to lower costs, and a lack of resources to invest in the technological infrastructure necessary to adequately manage supply chain processes.

CONCLUSION

Despite the many obstacles supply chain managers face in these organizations, improvements to the supply chain will undoubtedly provide children's hospitals with the opportunity to expand upon the incredible work they already do, while simultaneously improving the quality and cost of pediatric care. Through the use of hospital associations, like CHA, and group purchasing organizations, such as CHA-partner Vizient, Inc., children's hospitals can work together to grow a stronger buying alliance, in which they can more effectively negotiate pricing based upon group volume, receive supportive services regarding contracting and the adoption of standardization practices, access research and benchmarking data, as well as engage in a collaborative environment with CHA's 220 member hospitals.

Stated best by the Children's Hospital Association (2016), "Children's hospitals aren't just buildings," they are "the backbone of the nation's pediatric health care infrastructure, training the nation's pediatricians and pediatric specialists, researching cures for diseases that affect children and providing the highest quality care for children. From healthy kids in need of preventive care to those who are medically complex in need of a specialized medical home, all children benefit from the pediatric training, clinical care, research and child health advocacy provided together only in America's children's hospitals," and strengthening the supply chain is the key to furthering this mission.

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