University of Colorado Denver

HEALTH ADMINISTRATION RESEARCH CONSORTIUM
Research Brief

Volume 8 Issue 1
Spring 2023

REDESIGN OF HEALTH SYSTEMS' SUPPLY CHAINS

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INTRODUCTION

In the post-pandemic, healthcare supply chain redesigns have become essential for health systems leaders. Traditional healthcare supply chains were severely affected by disruptions both globally and locally. The pandemic caused pauses in material movement due to stringent government regulations that ultimately led to significant patient treatment delays. These roadblocks in the conventional supply chain process provided no leeway for health organizations to anticipate or prepare for disruptions.

Disruptions in healthcare supply chains can cause significant delays in the treatment process and threaten patient well-being[1]. Healthcare organizations constitute an intricate network of components that impact the health and well-being of a given population. Any disruption in this flow of resources in a network can hinder an organization's care delivery process. Healthcare supply chains are an integral part of this highly complex system.

The US health system is working towards a triple-aim approach, and cost reduction is a primary consideration in decision-making[2]. The focus on cost has incentivized healthcare organizations to concentrate on a few sources to leverage volumes of purchases for reductions in prices. This supply chain structure has made healthcare organizations rely heavily on a few intermediaries, such as distributors and group purchasing organizations (GPOs), to achieve volume purchasing discounts. This dependency, however, has far-reaching effects on supply chain resilience, making it vulnerable to impediments when faced with unanticipated transportation or production disruptions[3].

In general, healthcare organizations had an overreliance on overseas manufacturers before the pandemic. The cost considerations raised before made offshoring production to regions with relatively low labor costs necessary. Furthermore, most healthcare organizations had to operate with lean inventories to preserve scarce cash resources and have a cost-effective supply chain[3]. Depending on overseas suppliers while maintaining cost-effectiveness could have helped the development of alternate supply chain avenues. As a result, the penalty of not having such alternatives became apparent with disruptions in material flow during the pandemic. A few healthcare organizations could manage from immediate local supplies[4], while others collaborated to solve the troubles[5]. However, most health systems struggled with supply chain disruptions during the pandemic. Returning to prior relationships with overseas suppliers was not a solution for several health systems, given the severe delays in shipping or the fact that many suppliers and manufacturers went out of business. Thus, redesigning supply chains to provide agility and resilience has become essential for healthcare organizations to operate efficiently in the new normal. Thus, the question arises, how can health systems redesign their supply chains?

This research brief reflects on the importance of redesigning supply chains post-pandemic times and how health systems can adopt a strategy to do the redesigns effectively.

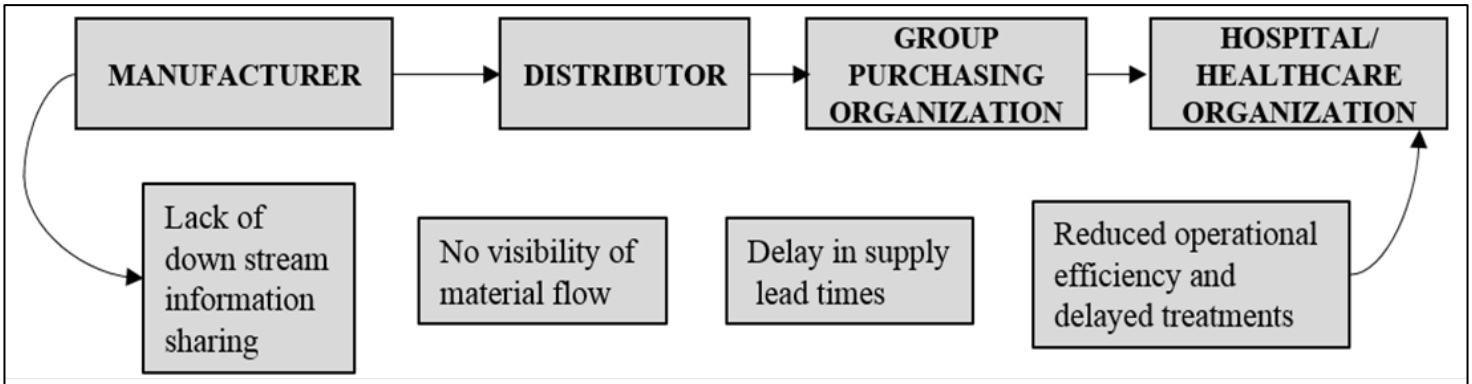

Figure 1: Lack of Transparency in Supply Chain Material Flow Delays Treatments

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The Need To Redesign For A Resilient Supply Chain For Health Systems

Health systems, without a doubt, need a resilient supply chain, a fluid process that adapts to changes to overcome disruptions[1]. Resiliency involves visibility across the supply chain and ensuring options across the visible material flows and vendors. Visibility can only happen when there is transparency in material flow. In the current traditional model, health organizations lack supply chain visibility and, thus, cannot foresee disruptions and succumb to their consequences. It is difficult for this model to adapt to change and is prone to fracture during a crisis. A better model would be when health organizations have a say in the supply chain decision-making process, thus, exercising more control over the journey of critical equipment from manufacturing to delivery. In this brief, we will explore and highlight plausible solutions to overcome the hindrances of this current model.

An organization's first order of business to proactively confront unexpected disruptions forms the basis for building a resilient supply chain[6]. Supply chain resiliency provides the ability to reduce the probability, consequences, and recovery time from disruptions[7]. However, a resilient supply chain is not built in one day, often taking multiple years as data resources are identified, demand is better understood, and vendor/distributor relationships are cultivated [8] . Organizations that are ready to manage a crisis can respond in a way that is different from others. This was the case during the pandemic. During this time, production and shipping disruptions prevented healthcare providers from receiving needed supplies.

Redesigning resilient supply chains at its drawing board level may involve numerous modeling approaches, including risk identification, assessment, mitigation approaches, optimization, simulation, mathematical programming, game theory, and queuing theory, to name a few. All these models or strategies boil down to a value proposition that the supply chain should be able to deliver goods when needed during a crisis. To develop a sustainable healthcare system, risk optimization serves as a vital tool to address insufficiencies in healthcare equipment and staff. Furthermore, having a solid disaster plan while implementing lean practices may help[9].

While complete remodeling is essential, doing so, i.e., building a robust set of suppliers or finding alternative manufacturers who can operate according to the needs and demands, takes work. In comparison, health systems that followed collaborative supply chain models worked with other systems and provided the necessary agility and resiliency during the pandemic[8]. The question is whether such a collaborative supply chain is suitable for all. Can it offer unique demands to specific health systems, such as those engaged with specialty care or disease-specific care deliveries? For instance, health systems involved with cancer or pulmonary diseases would need special equipment or medications not used by other health systems engaged with more routine care services. Therefore, specialty care health systems may have to develop supply chains that are completely vertically integrated and operate for their unique needs. Such supply chain development is easy to shape and relies on wholly collaborative or integrated approaches that further research can investigate.

Building Resiliency Using Integration and Collaborative Redesign Strategies

The demand in healthcare is such that it requires the supply chain to be fluid and dynamic despite regional and global disruptions. In the past, natural disasters, such as storms, hurricanes, and earthquakes, have impeded flow avenues in the supply chain network[9]. The pandemic, however, had the most far-reaching effects that linger on even nearly two years later. Therefore, addressing weaknesses in the traditional supply chain is essential by enabling it to be resilient when facing future situations as catastrophic as the pandemic.

The uncertainty of product availability and timely delivery arising from a sole or limited source supply chain strategy can compromise a healthcare organization's care process, quality, and outcomes[3]. With the US moving towards a value-based care process, the timely availability of inventory is of critical importance. Therefore, a resilient supply chain is an integral part of a broader strategy to improve performance on measures or expand population health initiatives. This sophisticated network demands that healthcare's complex involvement of people, activities, information, and other elements (such as material flow avenues) be rethought—meaning 'redesign of the supply chain.' [10]

The collaborative redesign among providers, manufacturers, and distributors allows joint decision-making. Redesigning the current monopolistic structure with better collaborative models offers more significant advantages through sharing anticipated product demand and expected production outputs. The presence of many

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organizations in a collaborative model allows room for partners to correspond in times of crisis to meet the needs at hand.[3] A joint effort is made to overcome disruptions. The integration provides transparency; [11] we can therefore anticipate potential disruptions early on. When health organizations integrate with suppliers, all parties can see where and how material flows. It allows health systems to modify product sourcing pathways when signs of disruption are noted. This is impossible with the current model as group purchasing organizations (GPO) and distributors need to disclose supply chain throughput information that may be critical to the health organization in material manufacture, transportation, or delivery. Previously, these GPO entities have treated that information as confidential, thereby limiting the ability of a provider to seek alternate product sourcing pathways[12].

Redesign Strategies to Overcome the Crisis

Redesigning the current structure to allow greater control by providers and healthcare organizations will enable them to participate in the supply chain decision-making process and smooth the flow of materials. For example, health systems' heavy reliance on GPOs creates uncertainty about product availability. GPOs often outsource product manufacturing to low- and middle-income countries to cut costs. However, during the pandemic, when the US relied on China to produce personal protective equipment (PPE), there was a massive scarcity due to government restrictions that limited factory production and delayed the transportation of goods[11]. When Bozeman Health in Montana saw these discrepancies, they contacted local suppliers to manufacture masks and PPE as alternate product sources[7]. Using these alternate sources prevented shortages that other health organizations faced. Bozeman's collaboration with local suppliers and teaching institutes enabled them to redesign their supply chain strategy into one that was resilient in the given situation. While global outsourcing may help reduce costs and achieve one part of the triple aim, other objectives for quality of care are threatened. Such a threat could manifest again should the US face another disruption as considerable as the global pandemic. Redesigning the supply chain process to one integrated or collaborative would make the system more resilient to future disruptions[3].

Supply chain integration offers complete transparency from supplier to the customer throughout the product life cycle. All stakeholders' information and communication systems can seamlessly exchange information through all planning, execution, and completion of transport and logistics operations[10]. Such collaboration differs from operational collaboration, where a supplier checks in with the buying organizations. The collaborative supply chain is an inter-organizational effort focusing on collective goals that deliver value to buying and selling organizations. However, the traditional approach that US health organizations are fixated on does not offer this level of transparency or flexibility as GPOs do not disclose certain confidential information for negotiations, thus hindering timely inventory availability[11]. Conversely, provider entities are not incentivized to share projected demand data, limiting suppliers' ability to plan efficient production runs.

The Collaborative Redesign Offers More Control In Joint Decision Making

Supply chain collaboration creates a platform for organizations to share decision-making, from the choice of manufacturers to transportation, deadlines, and dispatch

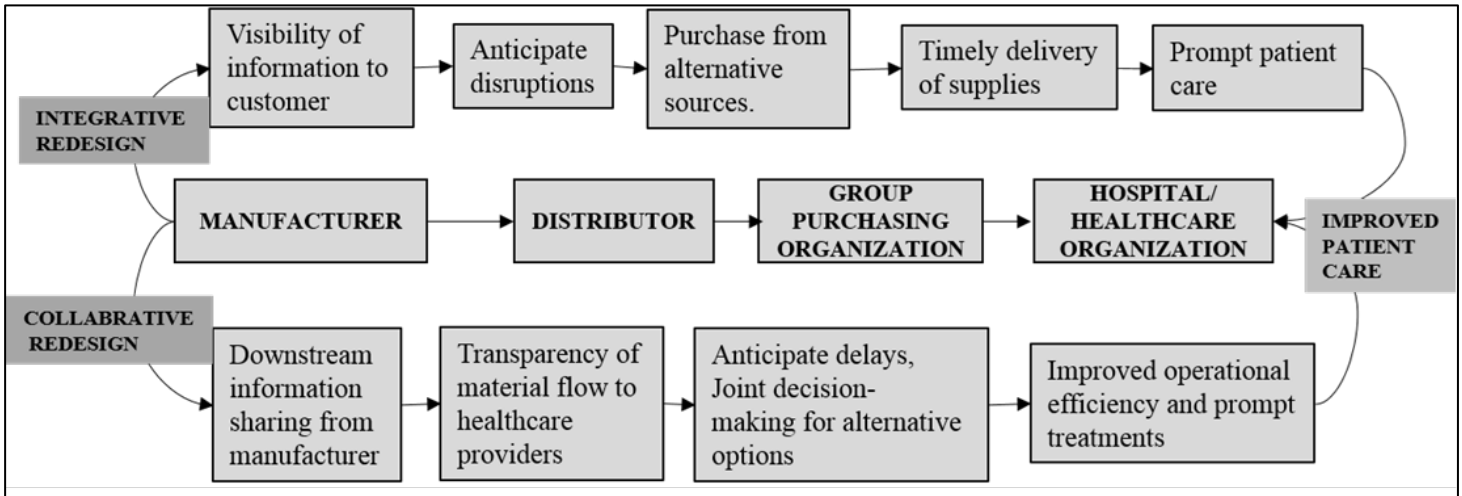

Figure 2: Collaborative and Integrative Redesign Strategies and Patient Care.

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times. This would provide a level of involvement unmatched by any other strategy. With supply chain collaboration, the active participation of many organizations would aid in quicker response to alternative solutions if the primary vendor/ manufacturer incurs delays[13]. If we look back to the pandemic's peak, significant pauses in production and movement of material due to over-reliance on single distributors caused massive disruptions[11]. Hospitals were sometimes left fighting to keep their patients alive but at the risk of personnel safety due to the lack of personal protective equipment.

Were supply chains collaborative, this challenge could have been dealt with quickly, and supplies obtained from alternative sources in time to meet patient care and staff safety needs? HCOs could have decided where and how the inventory was sourced. Therefore, redesigning a collaborative supply chain leverages suppliers' and buyers' knowledge and resources. Collaboration would facilitate an agile, flexible, and creative supply chain network[3].

Integrative Redesign Helps Health Systems Predict and See Disruptions Faster

Integrated supply chains offer transparency across all steps of material movement[3]. It closes the current gap with the uncertain availability of products and transit times. With integrated networks, information sharing would facilitate organizations to anticipate disruptions earlier and respond rapidly[14]. Health systems would have the flexibility to opt for services from another vendor should their primary source delay the supply process. It enables health systems to make effective decisions in a timely fashion that would not jeopardize patient care or staff safety. Health systems can make independent decisions about alternative distributors should they observe or predict disruptions in material movement—which will provide some level of control to health systems in confronting a crisis that currently does not exist with the conventional strategy.

Summary of Recent Research

A recent JMIR study by the Health Administration Research Consortium researchers addressed two critical questions to tease the nuances of supply chain integration versus collaborative redesign strategies for health systems[15]. First, the study explores the relationship between the perceived severity of supply chain-related challenges and disruptions and an organization's future partnership plans to address those challenges. Second, the study examines the relationship between supply chain partnerships and outcomes. It also explores the relationship between supply chain challenges and a dual-partnership mix. The 124 health systems surveyed and represented in this survey varied from 1 to 18 hospitals with 176-75,000 employees. The annual revenue 2020 of the health systems ranged from US $0.7 million to US $14 billion. The health systems aggregately represented US $300 billion in revenues and 1.1 million employees across the United States.

The study reports that disruptions festered by operational complexities of a supply chain within and between nodes and their inefficiencies seem to propagate redesign strategies through integration or collaboration to build resilient supply chains. The health system, however, is faced with unique challenges compared to other industries. Disruptions caused by health sector-specific delays due to regulatory pressures, long and stringent drug development cycles, and unpredictable patient mixes add to the complexities of inventory management, amplifying supply chain inefficiencies.

Supply chain disruptions are primarily determined by three factors, namely: density, complexity, and node criticality. Geographic spacing and quantity of supply chain nodes define density; the relationship between the number of nodes and their connections refers to supply chain complexity. Sourcing a significant portion of resources from impacted areas has a greater effect on highly dense areas, but more complex supply chains, although on the one hand, would face more disruptions and would serve as a buffer for supplier networks with the presence of additional nodes. Node criticality refers to the relative significance of a node; the greater the number of critical nodes, the greater the likelihood of incurring discrepancies in a supply chain.

Spatial complexity, degree of goal congruence, product and service characteristics, regulatory procedures, and physical characteristics of a health system are vital influencers in healthcare in determining strategic choices. Therefore, health systems must proactively develop strategies to continually evaluate supply chain operations to function resiliently despite incessant disruptive environments to minimize critical supply shortages.

Disruptions and challenges influence partnership choices. Organizations are most likely to opt for integrative strategies when faced with higher disruptions. Plausible reasons for this could be greater trust between partner organizations or avoidance of further burden through collaborative redesign's complexities. Although not directly, integrative strategies may also facilitate growth through improvements in service delivery.

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The main variables in the JMIR study[16] are supply chain disruptions and challenges, presenting growth opportunities, overall improvements in health delivery and services, integration with supply chain and logistics organizations, and redesign through startups or entrepreneurial collaborations. The influencing factors considered for this study are size, region, teaching status, revenue, and several other system characteristics.

The study found that healthcare supply chains significantly face higher disruptions and challenges. Supply chain issues shared a positive and significant relationship with partnership choice. Participating CEOs seemed more inclined towards improving services and delivery than growth opportunities. The choice between collaborative redesign, partnering with startup and entrepreneurial ventures, and integrating with logistics and supply chain organizations had similar takers. However, integration with logistics organizations was preferred over partnership with startups when there was higher anticipation of supply chain disruptions.

The study reports that in perceptions of higher challenges and disruptions, the most practical operational strategy was integrating with existing partners, possibly due to perceived reliability. In assessing what favors integration and collaboration, burdened systems chose integration over collaboration. Teaching, high-burden hospitals, physicians, and ownership status negatively influence integration and collaboration, whereas size and hospitals positively correlate with integration and collaboration.

The study also shows that supply chain integration primarily influences service improvement, whereas collaboration facilitates growth. Collectively, integration and collaboration promote growth. However, the effect of integration on growth and service improvements is influenced by the size, region, high-burden systems, and physicians. For example, integration does not positively affect growth and services for high-burden and disproportionate share hospitals. A positive relationship with service improvement existed with teaching hospitals, but growth was unfavorable.

Health systems that chose to redesign through collaboration yielded generally positive results. System size, high-burden systems, and physicians influence collaboration relationships on growth and service improvement. Conversely, ownership, revenue, high burden, and high disproportionate share of hospitals negatively correlated with service improvement. Teaching hospitals and regions shared a positive relationship only with service improvement, suggesting hospitals favor growth over service improvement.

Lastly, supply chain challenges had no significant relationship with dual partnership choice. Thus, the research findings suggest that hospitals can provide better services with supply chain integration, whereas growth opportunities are encouraged through collaborative supply chain redesign by increasing innovation and capability.

IMPLICATIONS

With higher perceptions of disruption, health organizations are inclined to integrate with existing partners, especially for high-burden systems, as they may not want to amplify the complexity of their current state. Organizations with higher revenue, however, may choose to redesign with collaborative approaches, likely due to their financial advantage.

While integration contributes to service improvements, collaboration is more favorable to growth. Integration may indirectly provide better growth opportunities by allowing resources to be redirected toward growth initiatives. A possible explanation for this could be that when high-burden systems integrate their supply chain operations, the flow of resources is more harmonious.

Collaboration with startups would provide a competitive advantage for health systems. In light of events that hinder shipments, health organizations may contact alternate suppliers to ensure the procurement of supplies. Additionally, policy interventions to mitigate financial risks associated with collaboration may facilitate dual partnership options to improve service and provide better growth opportunities.

ACKNOWLEDGMENT

This research brief is a part of the Health Administration Research Consortium's work on monitoring challenges and strategies for health systems. This ongoing research is made possible by the work of faculty at the University of Colorado Business School and the participation of healthcare executives nationwide.

CITE THIS RESEARCH BRIEF AS:

Joanna Chiyon Kumar, Jeff Helton, Xue Ning, and Jiban Khuntia (2023). "Redesign of Health Systems' Supply Chains" Health Administration Research Consortium Research Brief, University of Colorado Denver, Vol. 8, Issue 1, pp.1-5.

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