

THE PERILS AND PROMISE OF SUPPLY CHAINS IN HEALTHCARE: INSIGHTS FROM PANDEMIC

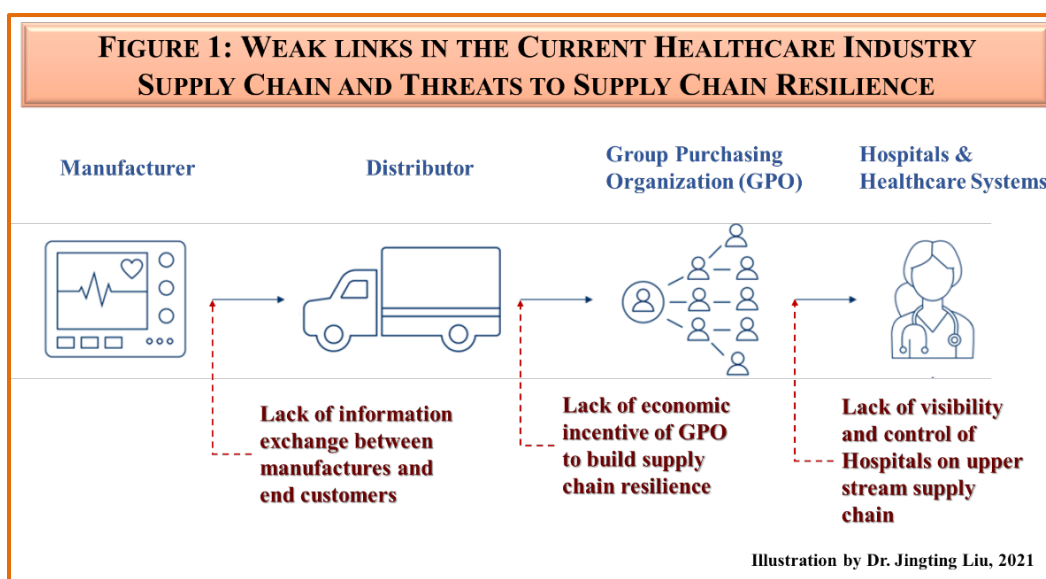
HARC - COVID-19 has devastating impacts throughout the world. Every government, industry, and population in the globalized world has been affected in some manner. A widely discussed impact is on the healthcare supply chains—both about the problems and challenges during the COVID-19 spread and uptake periods and the current challenges to managing vaccine distributions to eradicate the COVID-19. Lessons, insights, and experiences derived during the pandemic will propel the supply chain industry to think of newer directions and ways of operations. The rippling effect of supply chains will take some time to build; however, the rebuild effects’ promises also abound. Important points to ponder in this context:

- Will global supply chains need to be re-configured, especially for critical industries?
- How can a country like the United States protect any future disruptions and build supply chains’ resiliency?
- Are intelligent and integrated supply chains a myth or reality?

HARC sought faculty insights and opinions on the *perils and promise of supply chains* in this HARC perspective. **Dr. Jingting Liu**, an assistant professor in international business; **Dr. Jeff Helton**, an expert in health care operations and financial management areas; and **Dr. Jiban Khuntia**, information systems, and healthcare faculty, discussed with HARC research fellow **Mitchell Berning** to highlight several interesting points.

Challenges with Contemporary Healthcare Supply Chain

Figure 1 illustrates several pitfalls or weak links in the current supply chain of our healthcare industry. First of all, the supply chain is heavily dependent on intermediaries – intermediate distributors and group purchase organizations (GPO). While technically, hospitals and healthcare practices can source products directly from wholesalers and contracted distributors by original producers, in practice, most of them source supplies through GPOs. These GPOs aggregate purchase orders across different healthcare systems to achieve economy of scale and bargaining power over suppliers. Thus, GPOs typically offer lower prices than what individual hospitals can get themselves, which is the main attraction to hospitals.



GPO memberships are often nonexclusive, and hospitals can simultaneously join multiple GPOs. While this type of arrangement offers healthcare systems certain convenience and cost-efficiency levels, it also severely limits hospitals’ visibility and control on the upper stream supply chain. Quality and price of products negotiated and arranged by the GPOs on hospitals’ behalf. Hospitals have little say on supplier choices, intermediaries, and sourcing countries.

Additionally, the GPOs do not guarantee the availability, delivery time, quality, and price of supplies. Although U.S. states have price gouging laws, federal laws on cross-border trade do not necessarily prohibit price gouging. All these factors put the hospitals in a very vulnerable place. Such downside was manifested during the initial phase of the COVID-19 pandemic in the United States. When hospitals could not effectively source supplies such as PPE and ventilators, if GPOs continue to play a dominant role in the healthcare supply chain, regardless of the effort by healthcare systems such as hospitals and clinics, the supply chain's resilience can hardly be achieved. This is because GPOs' ultimate benefit comes from the price difference between producers and end customers, and the temporary shortages of supply do not directly affect GPOs themselves. Thus, GPOs are likely to continually depend on a small number of suppliers for lower costs, consequently pushing supply chain risks and inventory pressure to hospitals themselves. Without strict buy-local regulatory pressure, GPOs are also likely to continue global sourcing for lower prices as well.

Process and Measures for Supply Chain in Healthcare

The health care supply chain is a sequence of processes involving multiple organizations to provide the right supplies at the appropriate time to the correct location at a reasonable price in pristine condition for rendering patient care. These integrated processes require a free movement of goods, data, and funds between manufacturers, distributors or group purchasing organizations, and hands-on caregivers to efficiently and timely deliver resources. One of the most valuable resources needed to create an efficient and effective supply chain is exchanging information through distributed business intelligence (Langabeer & Helton, 2020). For that supply chain to be efficient, data and business intelligence must be integrated to predict demand, evaluate purchase options, and complete purchase/payment transactions. Innovations such as blockchain have great promise for improving supply chain performance in healthcare organizations. In particular, distributed intelligence to support the supply chain is a desirable tool in the supply chain for which blockchain technology is well suited (Dutta, Choi, Somani, & Butala, 2020). Recent changes in the demand for supplies arising from different patient care needs associated with the COVID-19 crisis have upset the norms in today's supply chain as demand predictions require wholesale revision. Alongside that change in predicted demand is a change in the mix of resources required for a COVID patient's care.

The high-performance supply chain should be measured based on four critical capabilities:

- Speed to bring products through the supply chain to the delivery of patient care
- Consistency in the product quality in all patient care sites
- Agility for the flexible sourcing of and responsive distribution of goods
- Innovativeness in product development, manufacturing, and distribution

Supply chains that can perform well across these domains and quickly recover from disruptive events (like the COVID pandemic) are considered resilient supply chains (Ponomarov & Holcomb, 2009). The effect COVID-19 has had on the healthcare supply chain needs to be viewed through a historical lens. Pandemics cause demands for essential products to increase exponentially while simultaneously driving down the supply of labor and raw materials, constraining production capacity (del Rio-Chanona et al., 2020).

The key difference between historical pandemics and the COVID-19 pandemic is one of scale. Never has humanity been so connected in terms of trade and travel. The sheer scale of this pandemic magnified the demand and supply issues; by late March 2020, 7 billion people worldwide competed for the same stockpile of essential products. This large scale run on essential products caused historical cracks in the supply chain to deepen and burst.

Reliance on Global Supply Chains

As the cracks began to burst, it became clear that the global supply chain infrastructure is over-reliant on offshoring, and "Just in Time" inventory was coming home to roost. **Dr. Jingting Liu** spoke about China's role in the COVID-19 supply chain disruption stating that "When the pandemic first hit China and enacted a national lockdown...the majority of production and

transportation of goods to be exported outside the country [was halted], and the rest of the world felt the shock to global supply chain given China's unique status as the world's factory".

The supply chain shockwave caused by the COVID-19 disruption on exports created panic throughout the western world. Dr. Liu continued: "Consequently, the fear of dependence on Chinese supply rose even higher, coupled with the nationalistic narrative by the Trump administration following the US-China trade war. Concerns over the potentially volatile Chinese supply chain have led some healthcare supply chain specialists to reassess how they receive essential material, such as personal protective equipment (PPE), ventilators, and pharmaceuticals. To the extreme, these shocks in the supply chain have even had local health care organizations working with local manufacturing firms to develop sources of personal protective equipment in local markets (Mark, 2020).

When global supply chain failure shock hit the U.S., shortages of essential supplies from China and elsewhere left healthcare providers scrambling for new ways to provide care to patients and protect employees. The lack of PPE hindered both direct patient care and maintenance of a healthy labor force. Shortages of specialized equipment, such as ventilators, forced healthcare employees to make decisions to ration the most effective treatments to patients with the highest survival potential.

Supply Chain Resiliency with Technology Options

The Department of Veterans Affairs provides essential insight into what American hospitals at large were experiencing during the pandemic. The United States Government Accountability Office (GAO) examined the Department of Veterans Affairs (VA) supply chain's resiliency and found significant issues. The nation's most extensive government-run hospital system's inventory management network is antiquated. Lack of supply chain resiliency led to PPE shortages needed to protect the frontline workforce during the COVID-19 response (Oakley, United States. Congress Senate Committee on Veterans, and United States Government Accountability, 2020). Like most hospitals in the U.S., the V.A. uses a "Just in Time" inventory supply model. Just-in-Time inventory works by limiting stock maintained on-site, allowing hospitals to minimize costs, reduce inventories, and drive-up asset utilization. For "Just-in-Time" to be successful, deliveries from international suppliers need to be predictable and consistent. The lack of both during the COVID-19 response caused the "Just-in-Time" supply model to fail. The lack of preparedness and shortcomings of current response plans show the need for greater supply chain resilience (del Rio-Chanona et al., 2020).

New supply chain technologies are emerging to aid supply chain transformation into a more robust system. Over the last several decades, the exponential evolution of technology has allowed for rapid transformation in supply chain logistics. Advancements such as digital supply chain networks and robotics have allowed companies to lower costs and increase profit margins. A modern healthcare provider's success is tightly correlated to supply chain performance, and the success of a supply chain has become contingent on technology investment. Healthcare leaders post-COVID-19 will need to assemble numerous technologies into a single framework capable of continually improving the process's resiliency and efficiency.

Blockchain, utilized as a cloud-based supply chain management, may provide improvements to the healthcare sector. Healthcare firms' supply lines are becoming more complex logistics networks than ever before. Using blockchain, healthcare firms can identify potential public and private risk sources with their supply lines. Digital supply chain networks allow healthcare firms to shorten the decision-making process associated with changing market needs and decrease supply chain risk while increasing overall transparency.

Digitization of the supply chain has been made possible through smart technologies being embedded into products and packaging. This allows devices to be "programmable, addressable, sensible, communicable, memoizable, and associable (Nasiri et al. 2020). Digital supply chain management has already improved the chemical industry. Chemical firms that invested in digitalization saw increases in profits of 5-20%, while one quarter saw profits grow more than 20% (Gautr, 2020). Profits are not the only benefits of digitizing supply chains.

Digital supply lines provide traceability, transparency, and accountability. Efficient supply lines need to be traceable. Digital supply chains incorporate bar code scanning and RFID technologies that allow the products to identify status to the supply chain backbone. This level of traceability allows auditors to inspect products in real-time, thus improving transparency. If a disruption does occur, such as the COVID-19 supply chain disruption, digital supply chains allow for real-time analysis and modification.

What the COVID-19 Vaccine Rollout is Teaching the World About Supply Chains

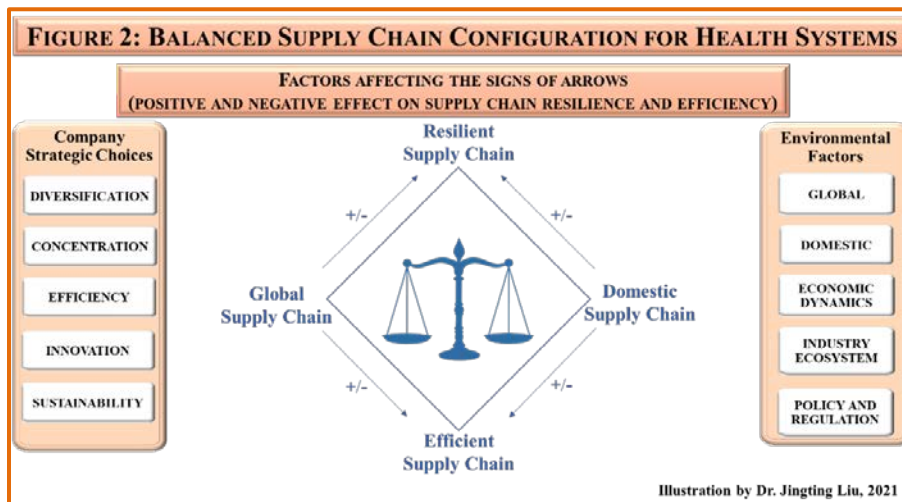
The 2020 COVID-19 vaccine distribution will be an early test of new supply chain technology. In 2019, McKesson, the primary supply chain distributor for the vaccine, signed a contract with a Blockchain company called Chronicled (<https://www.chronicled.com/>). The Silicon Valley startup specializes in assisting healthcare organizations building blockchain-powered supply chain networks (Miliard, 2019). Two COVID-19 vaccines are ready to be released as of this article writing, each with very different storage temperature requirements. Implementing a blockchain infrastructure into the vaccine rollout would help manufacturers and McKesson better manage the supply and demand. Blockchain could also help reduce inherent security concerns.

Dr. Helton pointed to the potential black market that might arise from the scarcity of vaccines. “Depending on the timing of the release of vaccine doses, it is conceivable that a “black market” could arise from the diversion of vaccines” (Helton, 2020). He pointed to lessons learned from prior work in hospitals and with research in pharmaceutical fraud. “Vaccines should be secured in storage, and the site protected with access controls to limit admission to only patients and staff” (Helton, 2020). Blockchain could be used as the central access control monitor.

The use of blockchain could extend beyond a security protocol. The Pfizer and Moderna COVID-19 vaccines could benefit from blockchain technology used to track and document the cold-storage-chain from manufacturer to end-user. Blockchain used as a digital vaccine supply chain would provide vaccine authenticity and ensure proper storage (Kim et al. 2020). As technology is leveraged to protect a supply chain’s integrity and security, inventory carrying costs could be reduced, leading to more significant amounts of financial resources being available elsewhere in the health care system. This is an essential consideration as health care organizations strive to optimize the amount of on-hand inventory needed to provide for patient care needs in the event of a disruption or extension of standard procurement lead times.

The Prospect of a Balanced Supply Chain

COVID-19 is a wake-up call to many healthcare systems to realize the vulnerability of their supply chain and the need to build resilience. Resilience is a multidimensional concept and requires various designs and actions in the hospitals themselves and their supply chain partnerships.



When economic activities and cross-border transactions were shut-down in various countries, the need to source locally or domestically become pressing. It indeed contributes to supply chain resilience if more dependable domestic suppliers are included who are free from political risks, currency risks, and other types of risks involved in global sourcing. However, we also need to realize the trade-off between supply chain resilience and efficiency. In other words, resilience comes at a price, primarily through domestic sourcing given high production cost and environmental protection regulations within the U.S. Therefore, it is essential for healthcare systems to aim and achieve a balance between resilience and efficiency of their supply chains through a combination of global sourcing and domestic sourcing arrangements. Another critical decision in addressing resiliency in the supply chain relates to the underlying need to provide a product to the patient as needed to meet clinical needs. Thus, the health care system must balance the low overhead cost of a just-in-time supply chain with the hedge against supply chain disruption provided by a supply-to-stock strategy where scarce cash resources are invested in procurement and security of supply inventories (Langabeer & Helton, 2020).

While blockchain has some promise to address immediate needs to meet patient care needs during the COVID pandemic, there is a more incredible long-term healthcare opportunity. In our current health care system, the adoption of technology to better plan and manage the replacement and sourcing of replacement goods is significantly behind other industries (Langabeer & Helton, 2020). Adopting blockchain can provide a much more robust solution to obtaining the myriad data required for a resilient supply chain, enabling nimbler sourcing of products from a more comprehensive array of vendors to track and secure goods in transit securely, making timely payments for goods.

It is important to note that the healthcare industry cannot do this alone. **Dr. Khuntia** points out that, “Hospitals and healthcare organizations are part of a broader health system that is interdependent on other parts [of the economy]. Collaboration and coordination with other partners are a must to ensure a robust healthcare supply chain”. Nearly every industry’s supply chain affects some aspect of healthcare. The agriculture supply chain involves the food supply entering hospitals and nursing homes. The industrial supply line ensures that the electrical grid remains robust. Even the oil and gas supply chains play a role in keeping a hospital’s backup generators topped off with diesel fuel. A more secure healthcare supply line would positively affect the security of the national supply chain. Implementing changes to the healthcare supply line is a matter of national imperative. It needs a holistic approach not only to improve supply chains in healthcare but across all industries—and plausibly, a set of technology and integration, and standardization-based approaches will help to sail this well.

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