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# LESSONS LEARNED FROM HUMANITARIAN LOGISTICS TO MANAGE SUPPLY CHAIN DISRUPTIONS

GYÖNGYI KOVÁCS AND IOANNA FALAGARA SIGALA
HUMLOG Institute, Hanken School of Economics

**The coronavirus disease 2019 (COVID-19) outbreak affects not just populations but also global and local economies and supply chains. The outbreak itself has impacted on production lines and manufacturing capacities. In response to the outbreak, policies have been put in place that blocks the movement of people and materials, causing supply chain disruptions. Mainstream supply chain management has been at a loss in responding to these disruptions, mostly due to a dominant focus on minimizing costs for stable operations, while following lean, just-in-time, and zero-inventory approaches. On the other hand, pandemic response supply chains, and their related supply chain disruptions, share many characteristics with disaster response and thereby with humanitarian supply chains. Much can thus be learned from humanitarian supply chains for managing pandemic-related supply chain disruptions. What is more, facing, and managing, supply chain disruptions can be considered the new norm also in light of other disruptive forces such as climate change, or financial or political crises. This article therefore presents lessons learned from humanitarian supply chains that help mitigate and overcome supply chain disruptions. These lessons not only relate to preparedness and mobilization, but also relate to standardization, innovation, and collaboration. Together, they brace organizations, supply chains, and societies, to manage current and future disruptions.**

***Keywords:*** *COVID-19; supply chain disruption; humanitarian supply chain; humanitarian logistics; medical supply chain; pandemic; epidemic; climate change*

## INTRODUCTION

The World Economic Forum estimates that in the decades to come, epidemics will on average cause an annual economic loss of 0.7% of global GDP, equal in scale to the global economic loss caused by climate change (WEF, 2019). The current coronavirus disease 2019 (COVID-19) pandemic constitutes a global healthcare crisis with far-reaching consequences on livelihoods and economies. The pandemic has had direct and indirect impacts and their cascades on the supply chain.

From the public health perspective, first and foremost, any pandemic impacts on the lives of people who have contracted the disease, and secondarily, on the healthcare professionals attending to these patients. Patients are though more than just individuals who need medical attention: through their positions and roles in society, they relate to, and impact on, families, social networks, employers and companies, and society and economy in general. From the socioeconomic perspective, anyone being ill implies a loss of knowledge, activities, and income to their employer, both a loss of income and a cost to the state, not to speak of the concern the situation causes to the patients themselves, as well as their family and friends.

From the supply chain perspective, a first, direct impact is on manufacturing plants that need to shut down if their workforce is sick or quarantined. Not only individual plants and production lines but also entire industries have been affected by such events. The next, indirect effects were felt through the supply chain, especially where alternative suppliers could not be found, or worse, and were impacted simultaneously. Further indirect effects appeared quickly on the horizon as a combination of export and travel bans, and later due to large-scale unemployment through a reduction of consumption. At the same time, the


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pandemic has induced a variety of irrational buying behavior, from panic buying to price speculation, further contributing to the bullwhip effect. Overall, COVID-19 has created both supply and demand uncertainties and capacity fluctuations, causing gaps and disruptions in global supply chains (Ivanov, 2020; Queiroz et al., 2020).

The current COVID-19 response goes to show that neither industry, nor governments, was adequately prepared for supply chain disruptions at such a scale (GPMB, 2019; WHO, 2020a, 2020b). Worryingly, the pandemic is just one reason for such supply chain disruptions. Climate change (Ghadge et al., 2020), financial crises (Jüttner & Maklan, 2011), terrorist attacks, and other political conflicts all increase supply chain risks and disruptions (Kleindorfer & Saad, 2005). To make things worse, their effects can also be concurring. More than ever, economies and societies would need to prepare to respond swiftly and effectively to such disruptions. The time has come for supply chains to embrace and implement the principles of supply chain flexibility, agility, responsiveness, and resilience.

Pandemic response medical supply chains share some characteristics with humanitarian supply chains, not the least as humanitarian supply chains have indeed responded to various types of disasters including epidemics and pandemics around the globe such as Ebola in 2014 and 2018, MERS in 2015, Zika in 2016, SARS in 2003, and H1N1 in 2009. Thus, a lot can be learned from humanitarian logistics and supply chain practice. Humanitarian supply chains focus on saving lives and on responding to disasters and emergencies, and are therefore geared toward dealing with turbulence, uncertainties, and complex dynamic environments (Day et al., 2012; Kovács & Spens, 2009; Van Wassenhove, 2006). After all, disasters including pandemics are not just singular disruptions in the supply chain but a result of complex multilayered factors and their impact.

The aim of this article was, therefore, to present key lessons learned from humanitarian supply chain practice in order to manage supply chain disruptions in other sectors. In the article, we highlight current and previous experiences from pandemic response, especially for the management of medical supply chains.

## LESSONS LEARNED FROM HUMANITARIAN LOGISTICS

Humanitarian organizations operate in peculiar complex environments. Some of the main challenges affecting humanitarian supply chains are the unpredictability of demand, lack of resources, poor infrastructure, and high dependency on donor funding (Balcik & Beamon, 2008; Gatignon et al., 2010; Kovács & Spens, 2007). The triple-A supply chain is much evident in disaster relief, where humanitarian organizations respond rapidly to short-term changes such as beneficiaries' demands (through agility), adapt to complex dynamic environments (adaptability), and integrate and co-ordinate processes with all participating partners (alignment) (Cozzolino et. al., 2012; L'Hermitte et al., 2016; Oloruntoba & Kovács, 2015; Van Wassenhove, 2006).

The humanitarian context arguably differs from the business one, primarily due to its not-for-profit aim (Kovács & Spens, 2007). That said, the same is true for public health, and thereby public health supply chains. Furthermore, from a supply chain perspective, the same concepts and principles apply, whether we talk of vendor managed inventory or the traceability of material flows. Overall, it is the concepts of agility, flexibility, responsiveness, and resilience we refer to for weathering turbulence and managing supply chain disruptions. The devil is in the detail. As Christopher & Holweg noted already in 2011, there are different approaches to flexibility (Christopher & Holweg, 2011) of which the humanitarian sector embraces structural flexibility as opposed to the more dynamic flexibility of business. These are thus lessons learned from structural flexibility.

### Prepare

Preparedness pays off. More than an overall mantra, extensive research has revealed a 1:7 ratio of return on investment between disaster preparedness and response (Stumpf et al., 2017). This is not surprising when considering pricing mechanisms (a sudden surge in demand resulting in a price hike for items and their transportation), capacity restrictions (in manufacturing and transportation), and the sheer urgency of disaster response. Preparedness includes a variety of activities, however. While the most discussed is pre-positioning, as to say, preparedness stock, it also includes having pretrained staff on rosters to be deployed, vetted, and preapproved suppliers as well as framework contracts with key suppliers, deployable funds, and even forecasts of disasters incl. their location and timing (Jahre et al., 2016; Kovács & Tatham, 2009). Sohn (2019) further distinguishes between curative and mitigative preparedness activities, adding mitigative activities that focus on the root causes of a disaster and the structuration of the response.

The COVID-19 pandemic showed that preparedness does not suffice at any one tier or organization in the supply chain but needs to be considered across the supply chain and across sectors. Pandemic preparedness requires the involvement of the private sector (manufacturers, wholesalers, logistic service providers), governments, and NGOs (Seddighi et al.,

2020). The humanitarian sector usually pre-positions relief items at strategic locations worldwide to be able to respond to humanitarian crises (Toyasaki et al., 2017). But pre-positioned stock alone doesn't suffice. To respond to global disruptions, there is a need for policy and legislation, global product standards and interoperable supply chains, capacity reservations, public–private partnerships, and co-ordination mechanisms between different supply chain members. The COVID-19 pandemic exposed not just a lack of preparedness stock but also a lack of global standards in medical supply chains (GPMB, 2020).

But even the very basics of preparedness, that is, to carry safety stock and pre-position it at strategic locations, works well in a pandemic. This is of course contrary to how business has implemented lean manufacturing principles, but in fact not contrary to lean management itself. After all, the complete elimination of safety stock requires predictable demand, and the possibility of frequent replenishment for just-in-time manufacturing. The very essence of disaster management, as well as pandemic response, is to manage eventualities, not certainties. Thus, pre-positioning inventory is a crucial strategy followed by humanitarian organizations to prepare for disasters including epidemics. Humanitarian organizations carry such stock either alone or jointly. For example, the United Nations Humanitarian Depot (UNHRD) system enables humanitarian organizations to borrow/lend materials from/to one another (Toyasaki et al., 2017). This system also mitigates the effects of panic buying and of price surges in the immediate aftermath of a disaster, or the advent of a pandemic. Setting-up pre-positioning mechanisms for medical items as well as essential goods at the regional or national levels, could in a similar vein increase the effectiveness of pandemic response, mitigate the effects of supply chain disruptions.

As for items such as personal protective equipment (PPE), we knew already from the 2014 Ebola crisis that neither global inventory nor global manufacturing capacity would suffice for any larger pandemic (Patel et al., 2017). Therefore, since that very epidemic, humanitarian organizations as well as the disaster management and public health organizations of various countries have stocked up on PPE to prepare for any new pandemic. Interestingly, medical preparedness does not only include PPE and critical drugs, but so-called interagency health kits can extend from cholera kits to entire field hospitals, or floating hospitals on vessels.

Joint pre-positioning could also be done for COVID-19 and pandemic response across organizations but also across countries. Currently, the members of the European Union collaborate under the framework of the rescEU program, which had been established in 2019 with the objective of enhancing the protection of citizens from disasters and the management of emerging risks. The program includes a vehicle reserve of, for example, firefighting equipment. More recently, in fact due to the COVID-19 outbreak in 2020, rescEU has started to pre-position ventilators, PPE, therapeutics, and laboratory equipment for pandemic response. After the initial competition for the same resources for medical equipment have shown clear deficiencies of pandemic response across the globe, joint pandemic response at least across the EU is finally in the making.

Joint procurement is another angle to such preparedness. rescEU has indeed also embraced joint procurement for potential COVID-19 vaccines. Earlier during the COVID-19 pandemic, governments have outbid one another for the same items, even when it came to reserving manufacturing capacities. Such behavior has not only led to further price hikes but also exacerbated further shortages, with suppliers promising the same items to several bidders. Joint procurement increases buyer negotiation power through economies of scale at the same time as it improves supply chain performance through stabilizing information flows (Xianglinga & Ping, 2018). Humanitarian organizations have a long history of engaging with joint procurement (Herlin & Pazirandeh, 2015). After initial hick-ups, UN agencies have implemented common supplier databases such as the United Nations Global Marketplace (UNGM system) where they can share information and due diligence on prequalified suppliers, with the possibility to piggy-back on each other's standing contracts. An example of joint procurement in the COVID-19 response is that of the International Federation of Red Cross and Red Crescent Societies (IFRC) that co-ordinates procurement in the Red Cross Movement. Similarly, the COVAX endeavor co-ordinates the procurement of potential COVID-19 vaccines and other necessary equipment for their administration. Other joint procurement endeavors have been implemented by specific countries, for example, Singapore's centralized procurement strategy that has assigned specific procurement agencies for groups of items in the COVID-19 response, and across countries, as in the EU.

Prior to the COVID-19 pandemic, companies have focused on reducing through contract manufacturing and lean manufacturing (Cozzolino et al., 2012), offshoring, and outsourcing (Hernandez & Haddud, 2018). These strategies do not prove sustainable when supply chains are disrupted in a pandemic situation (Yang et al., 2018). Now, companies and governments are learning that they should not rely on single suppliers but rather share resources where possible (Haque & Islam, 2018). If nothing else, the COVID-



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19 outbreak has shown the benefits of multiple sourcing, having several alternative suppliers at hand.

**Expedite**

The very speed of decision-making is imperative to humanitarian supply chains. It is encapsulated both in agility, that is, to respond to short-term disruptions quickly, and adaptability, to adjust supply chain design to meet structural shifts (Lee, 2004). As said, humanitarian organizations operate in chaotic environments characterized by unpredictability, uncertainty, ad hoc project supply chains, and rapid deployment on demand, including rapid changes in demand (Falagara Sigala et al., 2020). Agility helps humanitarian organizations to quickly and flexibly respond to demand fluctuations, supply disruptions, and changes in supplier delivery performance in different types of humanitarian disasters, varying geographical areas, and across dissimilar populations (Dubey & Gunasekaran, 2016).

Yet, urgency takes second place to decisions being "right." As every supply chain, the question is one of serving the customer, and also, humanitarian supply chains are mobilized upon a solid needs' assessment, which aggregates not just the needs of beneficiaries in terms of items and locations, but also the vulnerabilities and capacities of beneficiaries (Blecken, 2010). Sending the wrong items to a disaster area may congest entry points such as ports and airports, and have serious repercussions for handling and warehousing capacities of items that are in dire need but arrive later in the pipeline. Therefore, also humanitarian supply chains strive toward following pull principles, with pre-positioning covering only commonly needed standard items to bridge initial order and manufacturing lead times. At the same time, however, rarely can decisions in disaster relief or pandemic response wait for getting something completely right, as optimization techniques require data one doesn't yet have, or insights that are yet to come.

In the meanwhile, there are different ways how humanitarian supply chains reduce lead times in their decision-making. Pre-positioning itself is an interesting speculation strategy of what will be needed, reducing order lead times, and the location of pre-positioned stock reduces delivery lead times by being close to its destination (Balcik & Beamon, 2008; Duran et al., 2011). Even vendor managed inventory is used that combines the reduction of order lead times with ensuring dedicated product quantities, while decoupling these from financial transactions to suppliers to any later placement of an order (Kovács & Tatham, 2009). Furthermore, due diligence and prequalifying suppliers reduce order lead times, as these are preparedness activities that can be done much in advance to the occurrence of a disaster. Likewise, modal choice goes hand in hand with delivery schedules and the urgency of a delivery—though sadly, sometimes modal choice is dictated by the perception of air transportation being "urgent" and by definition an emergency mode of transportation, rather than the use of de facto fastest delivery modes (Tatham et al., 2015).

While some of the above supply chain practices have been used in other sectors as well, the humanitarian sector has even more to offer. To expedite needs' assessment, the sector has used "quake jumpers" in mountainous areas and even predeployed needs' assessment teams into the eye of hurricanes. Seabasing has been explored as a concept to move inventory, or field hospitals, closer to destination areas while staying out of the disaster itself (Tatham et al., 2015). More systematically, forecasting has become increasingly used in the humanitarian sector. Here, forecasting refers to demand forecasting in terms of materials and funding, and, in addition, to the potential deployment of manpower. Even more interesting is the integration of hydro-meteorological (climate and weather) forecasts with the activation of procurement, the mobilization of supplies and funds, and the deployment of people. An important aspect of such expedited modus operandi is the decoupling of fundraising from disaster response. This requires the existence of general funds that can be used on the basis of probabilistic forecasts. Supply chains could but learn from such liquidity and probabilistic decision-making.

**Standardize**

Few sectors are as regulated as healthcare (Field, 2007). There are specific regulations for import and export, lists of "approved drugs" for specific countries, regulations on the organizations as well as the people allowed to handle specific items, as well as temperature, humidity, and hygiene requirements for the storage, movement, and materials handling of most healthcare-related items. Again, this is less surprising when contemplating the potential adverse effects of drugs that have not just lost their efficacy but may endanger human lives if having been handled inappropriately, or faulty equipment, or any PPE that does not in fact protect the way it was intended to. Notwithstanding these considerations, it is astounding how many scandals we have seen recently around the world that involved facemasks that upon delivery turned out not to be of the promised standard or quality.

To make our lives easier, the World Health Organization (WHO) frequently publishes the standard technical specifications recommended for use of, for example, PPE in the COVID-19 pandemic. (They do it for other epidemics and communicable diseases as

well.) Yet, standards across continents don't match, and, for example, the Chinese, U.S., and EU standards for medical facemasks are not quite each other's equivalents. Yet at the end of the day, the manufacturer of a product can vary, but the quality should not.

At the same time, few medical items are stand-alone ones. The administration of vaccines will require syringes and gloves, the administration of a COVID-19 test not just test swabs but PPE, as well as related laboratory equipment and materials. To speed up the deployment of any urgent such items, humanitarian organizations have come together to develop (interagency health) kits for specific purposes: malaria kits and cholera kits, to entire field hospitals. These interagency health kits even standardize across organizations what to expect each box of a kit to contain (Vaillancourt, 2016). Thereby, if one organization procures a kit, another gets the funding to mobilize it, but it is used by a third in the field, any one logistician or healthcare staff would know what to expect where, and how to use it. This is a high level of not just standardization of items and equipment, but also of processes, enabling the interoperability of healthcare provision.

Equally importantly, there is no such thing as a local medical supply chain. While many industries tend to now insource and re-shore their activities, this is not an option for most medical items. The ingredients for specific drugs do not necessarily grow everywhere in the world, and to get the licenses to manufacture drugs or medical equipment is a lengthy process (Lurie et al., 2020). Yet in the COVID-19 pandemic, we have witnessed ridiculous situations in which one country would restrict the export of painkillers to another, while the other bans the export of ventilators to the first. Nobody wins from such practices, and only by recognizing the problem of such pandemic-driven trade wars and overcoming them can we address the actual problem of pandemic response.

## Innovate

Humanitarian supply chains may not be well known for innovation, yet there are lots of interesting endeavors in this regard. Much propagated have been technological innovations, from the use of drones and even zeppelins, to the use of additive manufacturing, or the application of blockchain to trace deliveries. Tatham et al. (2017) have even coined the phrase of "flying maggots" to depict the use of long-endurance remotely piloted aircrafts (aka drones) to deliver medical maggots for maggot debridement therapy to remote communities in Australia.

The COVID-19 pandemic response gives space for similar technological innovations. During the 2014–15 Ebola crisis, people delivering aid risked being quarantined as well, leading to an unwillingness of drivers and pilots to enter quarantine zones, and logistics service providers to expose their workforce. Logistics service providers were further worried about the vehicles and other equipment being stuck in such a situation, as airplanes would not be able to fly back without any crew. A different approach for medical deliveries would thus be the use of unmanned aerial vehicles (UAVs, drones) that do not expose any person to pandemics. UAVs are already in place for other medical deliveries. For example, in Rwanda, critical items such as snake antivenom, vital blood supplies, and other medication are delivered through drone hub and spoke systems. Other technological innovations include the use of additive manufacturing (3D printing) of medical equipment (Attaran, 2020; Tino et al., 2020), or of blockchain applications to track contagion and sustain medical supply chains (Dounia Marbouh et al., 2020).

The COVID-19 pandemic has brought also other, business model innovations to the forefront. There are abundant cases of production changeover, for example, automotive and aerospace manufacturers producing ventilators; distilleries producing hand sanitizers, or, in transportation, stranded passenger planes being converted to cargo planes. The latter is the more important as much of medical transportation uses belly cargo; thus, stranded passenger planes contribute to supply chain disruptions.

The ultimate innovation in the humanitarian supply chain is that of removing the delivery of items altogether. This is encapsulated in the idea of cash-based interventions (Heaslip et al., 2018). Social care, and healthcare, has embraced the same across many countries—but not all. The very absence of paid sick leave is a danger in pandemics, as people cannot afford staying away from their work when sick, thereby further contributing to the spread of the disease. Companies would fare much better if they could contain the spread and not expose their operations to sick employees, whichever way they would ensure that their employees are able to access and afford their healthcare and sick leave. To reiterate from a supply chain perspective, a sick workforce leads to the closure of operations, and further disruptions in the supply chain.

## Collaborate

Production changeover for pandemic response in the COVID-19 pandemic demonstrates the importance of industry, that is, the private sector, to be able to adjust its production capacity. In some cases, such changeover was government-initiated, with governments asking the automotive sector to produce respiratory ventilators. In others, companies saw new business opportunities and



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took the initiative to produce items such as hand sanitizers and personal protective equipment. Generally, cross-sector collaboration and public–private sector partnerships play an important role in building supply chain resilience in disaster-affected areas (Balcik et al., 2010; Carland et al., 2018; Tomasini & Van Wassenhove, 2009; Van Wassenhove, 2006). Public–private partnerships are expected to result in improved service provision, to help disaster agencies learn about business supply chains (Falagara Sigala & Wakolbinger, 2019; Van Wassenhove, 2006), but also, to legitimate the role of industry in society (Rueede & Kreutzer, 2014). Overall, there is a need for more effective public–private collaboration in the area of pandemic response. Establishing framework agreements between governmental agencies and suppliers would facilitate the supply process during disaster and pandemic response. In the humanitarian sector, framework agreements are tools to secure relief items and improve the efficiency and effectiveness of the response. Through them, humanitarian organizations can fix prices and freight rates for orders during a specified period of time (Gossler et al., 2019; Pazirandeh & Herlin, 2014). But even without agreeing on prices in advance, the sheer prequalification of suppliers speeds up the procurement process during an emergency.

Apart from such supply chain collaboration, humanitarian organizations also co-ordinate their efforts. There is a "cluster system" for large-scale disasters, where lead agencies of thematic clusters (e.g., WHO for the health cluster, WFP for the logistics cluster) coordinate disaster response across myriads of humanitarian organizations. These clusters meet periodically on the global level and are activated for specific disasters also locally. In parallel, there are numerous other endeavors that support collaboration across the sector; from umbrella organizations for specific groups of humanitarian organizations, to communities of practice such as the Humanitarian Logistics Association. Importantly, these are used not only to exchange ideas but serve as platforms where standards are set, from the Sphere standards, for example, specify the minimum quantities of various materials needed per person in a disaster, to interagency health kits, or the current effort to develop universal logistics standards. From a logistical perspective, such interagency collaboration can be even more practical and assist in co-ordinating humanitarian convoys, to jointly prepositioning stock around the globe. Some of these collaborative efforts would not be replicable in a business environment, for example, interagency supply chain visibility of stock and pipelines in ERP systems would be inhibited by antitrust regulations, but others such as product and process standards, and platforms to exchange ideas, can be used in any situation.

## CONCLUSIONS AND FUTURE RESEARCH

During the last decades, the mainstream focus of supply chain management was on cost efficiencies and minimization through just-in-time approaches and an outright avoidance of holding inventory (Simchi-Levi & Simchi-Levi, 2020). This is indeed a great approach for stable operational environments with foreseeable demand and long-term supplier relationships. These descriptors do not fit all supply chains, however. It is not only pandemic response that needs to be agile, but also humanitarian supply chains. More and more flexibility is needed in other areas as well, whether due to omni-channel retail, or ever higher degrees of customization. Moreover, all supply chains that follow such principles are prone to break down when facing a disruption. Disasters, and pandemics, have often been disregarded as highly improbable events; however, high their impact would be. Pandemics such as the COVID-19 outbreak have been described as "black swans," even if they are not in fact once in a lifetime events.

It is high time to consider high-impact disruptors in the supply chain. Pandemics are a case in point, but other similar disruptions can stem from climate change, financial crises, terrorist attacks, and political conflicts. Insurance companies, for example, routinely develop global risk maps for supply chains, where they highlight geopolitically risky spots. Companies would do well to consider the mechanisms presented here to mitigate those potential geopolitical risks, such as avoiding single sourcing from risky locations, to carrying safety stock to bridge eventualities. Moreover, as emphasized in humanitarian supply chains, preparedness means more than just pre-positioned inventory but is engrained in people and their training, as well as supplier databases and due diligence of prequalified suppliers. Overall, many of the elements of structural flexibility can be useful for any industry for mitigating future supply chain disruptions. Such structural flexibility is embedded in humanitarian supply chain research, but not well understood outside of that domain. Further research would be needed to learn and implement lessons from humanitarian supply chains in (public) healthcare and industry alike.

In parallel, product and process standardization (and modularization) can enable interoperability in the supply chain and across competitors. In industry, this can become a fine balancing act between the strive for differentiation and the streamlining of operations. In public health, however, truly global standards can mean the difference between life and death. It is time to embrace them.

An important further idiosyncrasy of humanitarian supply chains lies in their mechanisms to activate and mobilize the supply chain on the basis of



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probabilistic forecasts. With regard to these, we can learn from humanitarian supply chains that forecast not only the weather but also the climate. The question is not one of *whether* climate change will impact on us, on our livelihood, and on how we can run any business or supply chain, but *how* it will impact on any of these. It is high time to move beyond the question of whether supply chains should be green, sustainable, and responsible, to operationalizing what it means for them to do so. Humanitarian supply chains use probabilistic forecasts to determine the timing of activating procurement and deploying people. The even larger question is the one of preserving our habitat, or even the planet with or without us humans. Much research has focused on reducing $CO_2$ emissions, but very little on reducing our needs for (already scarce) resources. Yet, it is our constant need for those resources that lead to conflicts from trade wars to actual warfare. Interestingly, humanitarian supply chain design has been shown to be instrumental in promoting peace (Gibbs, 2009). To date, very little attention has been paid to questions of supply chain design, or supply chain disruptions, with regard to climate change, or peace. While to date the focus is on pandemics, further research is needed to embrace these topics in supply chain management as well.

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## REFERENCES

Attaran, M. (2020). 3D Printing role in filling the critical gap in the medical supply chain during COVID-19 pandemic. *American Journal of Industrial and Business Management*, 10, 988–1001.

Balcik, B., & Beamon, B. M. (2008). Facility location in humanitarian relief. *International Journal of Logistics*, 11, 101–121.

Balcik, B., Beamon, B. M., Krejci, C. C., Muramatsu, K. M., & Ramirez, M. (2010). Coordination in humanitarian relief chains: Practices, challenges and opportunities. *International Journal of Production Economics*, 126, 22–34.

Blecken, A. (2010). Supply chain process modeling for humanitarian organizations. *International Journal of Physical Distribution & Logistics Management*, 40, 675–692.

Carland, C., Goentzel, J., & Montibeller, G. (2018). Modeling the values of private sector agents in multi-echelon humanitarian supply chains. *European Journal of Operational Research*, 269, 532–543.

Christopher, M., & Holweg, M. (2011). Supply Chain 2.0: Managing supply chains in the era of turbulence. *International Journal of Physical Distribution & Logistics Management*, 41, 63–82.

Cozzolino, A., Rossi, S., & Conforti, A. (2012). Agile and lean principles in the humanitarian supply chain: The case of the United Nations world food programme. *Journal of Humanitarian Logistics and Supply Chain Management*, 2, 16–33.

Day, J. M., Melnyk, S. A., Larson, P. D., Davis, E. W., & Whybark, D. C. (2012). Humanitarian and disaster relief supply chains: A matter of life and death. *Journal of Supply Chain Management*, 48, 21–36.

Dounia Marbouh, D., Abbasi, T., Maasmi, F., Omar, I. A., Debe, M. S., Salah, K., Jayaraman, R., & Ellahham, S. (2020). Blockchain for COVID-19: Review, opportunities and a trusted tracking system. *TechRxiv*, https://doi.org/10.36227/techrxiv.12609344.v1

Dubey, R., & Gunasekaran, A. (2016). The sustainable humanitarian supply chain design: Agility, adaptability and alignment. *International Journal of Logistics: Research and Applications*, 19, 62–82.

Duran, S., Gutierrez, M. A., & Keskinocak, P. (2011). Pre-positioning of emergency items for CARE International. *Interfaces*, 41, 223–237.

Falagara Sigala, I., Kettinger, W. J., & Wakolbinger, T. (2020). Digitizing the field: Designing ERP systems for Triple-A humanitarian supply chains. *Journal of Humanitarian Logistics and Supply Chain Management*, 10, 231–260.

Falagara Sigala, I., & Wakolbinger, T. (2019). Outsourcing of humanitarian logistics to commercial logistics service providers: An empirical investigation. *Journal of Humanitarian Logistics and Supply Chain Management*, 9, 47–69.

Field, R. I. (2007). *Health care regulation in America: Complexity, confrontation and compromise*. New York, NY: Oxford University Press.

Gatignon, A., Wassenhove, L. N., & Charles, A. (2010). The Yogyakarta Earthquake: Humanitarian relief through IFRC's decentralized supply chain. *International Journal Production Economics*, 126, 102–110.

Ghadge, A., Wurtmann, H., & Seuring, S. (2020). Managing climate change risks in global supply chains: A review and research agenda. *International Journal of Production Research*, 58, 44–64.

Gibbs, D. N. (2009). *First do no harm: Humanitarian intervention and the destruction of Yugoslavia*. Nashville, TN: Vanderbilt University Press.

Gossler, T., Wakolbinger, T., Nagurney, A., & Daniele, P. (2019). How to increase the impact of disaster relief: A study of transportation rates, framework agreements and product distribution. *European Journal of Operational Research*, 274, 126–141.

GPMB, Global Preparedness Monitoring Board (2019). *A World at Risk. Annual Report on Global Preparedness for Health Emergencies*. Geneva: GPMB, Global Preparedness Monitoring Board. Retrieved from https://apps.who.int/gpmb/assets/annual_report/GPMB_annualreport_2019.pdf. Accessed Sept 18th, 2020.



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GPMB, Global Preparedness Monitoring Board (2020). *A world at disorder. Annual report on global preparedness for health emergencies*. Geneva: GPMB, Global Preparedness Monitoring Board. Retrieved from https://apps.who.int/gpmb/assets/annual_report/GPMB_AR_2020_EN.pdf. Accessed Sept 18th, 2020.

Haque, M., & Islam, R. (2018). Impact of supply chain collaboration and knowledge sharing on organizational outcomes in the pharmaceutical industry of Bangladesh. *Journal of Global Operations and Strategic Sourcing*, 11, 301–320.

Heaslip, G., Kovács, G., & Haavisto, I. (2018). Innovations in humanitarian supply chains: The case of cash transfer programmes. *Production Planning and Control*, 29, 1175–1190.

Herlin, H., & Pazirandeh, A. (2015). Avoiding the pitfalls of cooperative purchasing through control and coordination: Insights from a humanitarian context. *International Journal of Procurement Management*, 8, 303–325.

Hernandez, F. D., & Haddud, A. (2018). Value creation via supply chain risk management in global fashion organizations outsourcing production to China. *Journal of Global Operations and Strategic Sourcing*, 11, 250–272.

Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. *Transportation Research Part E*, 136, 101922.

Jahre, M., Pazirandeh, A., & Van Wassenhove, L. (2016). Defining logistics preparedness: A framework and research agenda. *Journal of Humanitarian Logistics and Supply Chain Management*, 6, 372–398.

Jüttner, U., & Maklan, S. (2011). Supply chain resilience in the global financial crisis: An empirical study. *Supply Chain Management: An International Journal*, 16, 246–259.

Kleindorfer, P., & Saad, G. (2005). Managing disruption risks in supply chains. *Production and Operations Management*, 14, 53–68.

Kovács, G., & Spens, K. M. (2007). Humanitarian logistics in disaster relief operations. *International Journal of Physical Distribution & Logistics Management*, 37, 99–114.

Kovács, G., & Tatham, P. (2009). Responding to disruptions in the supply network – From dormant to action. *Journal of Business Logistics*, 30, 215–229.

Kovács, G., & Spens, K. M. (2009). Identifying challenges in humanitarian logistics. *International Journal of Physical Distribution and Logistics Management*, 39, 506–528.

Lee, H. L. (2004). The triple-A supply chain. *Harvard Business Review*, 82, 102–112.

L'Hermitte, C., Tatham, P., Brooks, B., & Bowles, M. (2016). Supply chain agility in humanitarian protracted operations. *Journal of Humanitarian Logistics and Supply Chain Management*, 6, 173–201.

Lurie, N., Saville, M., Hatchett, R., & Halton, J. (2020). Developing Covid-19 vaccines at pandemic speed. *New England Journal of Medicine*, 382, 1969–1973.

Oloruntoba, R., & Kovács, G. (2015). A commentary on agility in humanitarian aid supply chains. *Supply Chain Management: An International Journal*, 20, 708–716.

Patel, A., D'Alessandro, M. M., Ireland, K. J., Greg Burel, W., Wencil, E., & Rasmussen, S. A. (2017). Personal protective equipment supply chain: Lessons learned from recent public health emergency responses. *Health Security*, 15, 244–253.

Pazirandeh, A., & Herlin, H. (2014). Unfruitful cooperative purchasing. *Journal of Humanitarian Logistics and Supply Chain Management*, 4, 24–42.

Queiroz, M. M., Ivanov, D., Dolgui, A., & Fosso Wamba, S. (2020). Impacts of epidemic outbreaks on supply chains: Mapping a research agenda amid the COVID-19 pandemic through a structured literature review. *Annals of Operations Research*. https://doi.org/10.1007/s10479-020-03685-7.

Rueede, D., & Kreutzer, K. (2014). Legitimation Work within a cross-sector social partnership. *Journal of Business Ethics*, 128, 39–58.

Seddighi, H., Seddighi, S., Salmani, I., & Sedeh, M. S. (2020). *Public-private-people partnerships (4P) for improving the response to COVID-19 in Iran*. Cambridge, UK: Cambridge University Press. Retrieved from https://www.cambridge.org/core/services/aop-cambridge-core/content/view/A07460CB528A665DB49616720E732EFF/S1935789320002025a.pdf/div-class-title-public-private-people-partnerships-4p-for-improving-the-response-to-covid-19-in-iran-div.pdf. Accessed Sept. 28th. 2020.

Simchi-Levi, D., & Simchi-Levi, E. (2020). *We need a stress test for critical supply chains*. Brighton, MA: Harvard Business Review. Retrieved from https://hbr-org.cdn.ampproject.org/c/s/hbr.org/amp/2020/04/we-need-a-stress-test-for-critical-supply-chains. Accessed Sept. 28th 2020.

Sohn, M. (2019). *Humanitarian logistics preparedness for recurring small-scale disasters based on seasonal climate information*. Economics and Society 328. Helsinki, Finland: Hanken. Retrieved from https://helda.helsinki.fi/dhanken/handle/10227/243217. Accessed Sept. 14th, 2020.

Stumpf, J., Guerrero-Garcia, S., Lamarche, J.-B., Besiou, M., & Rafter, S. (2017). *Supply chain expenditure & preparedness investment opportunities in the humanitarian context*. Paris, France: Action Contre la Faim–ACF. Retrieved from https://www.actioncontrelafaim.org/wp-content/uploads/2018/05/ACF_Report_Supply-Chain-Exp-and-Inv.-Opportunities_20171124_Final.pdf. Accessed Sept. 14th, 2020.

Tatham, P., Kovács, G., & Vaillancourt, A. (2015). Evaluating the applicability of sea basing to support the preparation for, and response to, rapid



1745493x, 2021, 1, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/jscm.12253 by Turkey Cochrane Evidence Aid, Wiley Online Library on [10/01/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

onset disasters. *IEEE Transactions on Engineering Management*, 63, 67–77.
Tatham, P., Stadler, F., Murray, A., & Shaban, R. Z. (2017). Flying maggots: A smart logistic solution to an enduring medical challenge. *Journal of Humanitarian Logistics and Supply Chain Management*, 7, 172–193.
Tino, R., Moore, R., Antoline, S., Ravi, P., Wake, N., Ionita, C. N., Morris, J. M., Decker, S. J., Sheikh, A., Rybicki, F. J., & Chepelev, L. L. (2020). COVID-19 and the role of 3D printing in medicine. *Printing in Medicine*, 6(11). https://doi.org/10.1186/s41205-020-00064-7.
Tomasini, R. M., & Van Wassenhove, L. N. (2009). From preparedness to partnerships: Case study research on humanitarian logistics. *International Transactions in Operational Research*, 16, 549–559.
Toyasaki, F., Arikan, E., Silbermayr, L., & Falagara Sigala, I. (2017). Disaster relief inventory management: Horizontal cooperation between humanitarian organizations, the case of UNHRD. *Production and Operations Management*, 26, 1221–1237.
Vaillancourt, A. (2016). Kit management in humanitarian supply chains. *International Journal of Disaster Risk Reduction*, 18, 64–71.
Van Wassenhove, L. N. (2006). Humanitarian aid logistics: Supply chain management in high gear. *The Journal of the Operational Research Society*, 57, 475–489.
WEF, World Economic Forum (2019). *Outbreak readiness and business impact. Protecting lives and livelihoods across the global economy*. Geneva, Switzerland: World Economic Forum. Retrieved from https://www.weforum.org/whitepapers/outbreak-readiness-and-business-impact-protecting-lives-and-livelihoods-across-the-global-economy. Accessed June 10th, 2020.
WHO, World Health Organization (2020). *The COVID-19 pandemic: Lessons learned for the WHO European Region*. Geneva, Switzerland: WHO. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/334385/WHO-EURO-2020-1121-40867-55292-eng.pdf?sequence=1&isAllowed=y. Accessed Sept. 28th, 2020.
WHO, World Health Organization (2020a). *Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19)*. Geneva, Switzerland: WHO. Retrieved from https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf. Accessed Sept. 18th, 2020.
Xianglinga, H., & Ping, S. (2018). The newsvendor's joint procurement and pricing problem under price-sensitive stochastic demand and purchase price uncertainty. *Omega*, 79, 81–90.
Yang, Q., Wang, Q., & Zhao, X. (2018). A taxonomy of transaction-specific investments and its effects on cooperation in logistics outsourcing relationships. *International Journal of Logistics Research and Applications*, 22, 557–575.

**Gyöngyi Kovács** ((DSc, Econ), Hanken School of Business) is the Erkko Professor in Humanitarian Logistics, which is the first professorship in humanitarian logistics worldwide, and is the Subject Head of Supply Chain Management and Social Responsibility at the Hanken School of Economics, in Helsinki, Finland. She is a founding Editor-in-Chief of the Journal of Humanitarian Logistics and Supply Chain Management (JHLSCM) and is on the editorial board of several other journals. She was the first Director of the Humanitarian Logistics and Supply Chain Research Institute (HUMLOG Institute) and has published extensively in the areas of humanitarian logistics and sustainable supply chain management. Currently, she is leading a Horizon 2020 (EU) COVID-19 project called "HERoS" (Health Emergency Response in Interconnected Systems).

**Ioanna Falagara Sigala** (PhD, Veinna University of Economics and Business) is a project researcher in the H2020 HERoS project at the HUMLOG Institute, Hanken School of Economics, in Helsinki, Finland. She holds a PhD from Vienna University of Economics and Business with the focus on the coordination and cross-sector collaboration in humanitarian supply chains. Her research interests lie primarily in the areas of humanitarian supply chains, public-private partnerships, the outsourcing of logistics and the pre-positioning of relief items.



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