Proceedings of the 11th Annual World Conference of the
Society for Industrial and Systems Engineering,
2022 SISE Virtual Conference
October 6-7, 2022

A Systems Dynamics Modeling of Mitigation Responses to Achieve Pandemic Disruption Preparedness: A Focus on Government Response and the Health Care Supply Chain Network

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Abstract: This paper investigates the healthcare supply chain (HCSC) and related the government's policy response to a pandemic disruption with the application of system dynamics simulation to improve the resilience and robustness before, during, and after a disruption, such as Covid-19. Currently, the majority of supply chains are designed to be in a steady state commercial mode and few are designed for resilience. The current Covid-19 pandemic affects both supply and demand of products and services of the HCSC. This study also explores the exogenous factors, such as, the federal government's response concerning policies and strategic decisions that can affect the vaccine distribution segment of the supply chain. The aim of this research is to analyze the behavior of a healthcare supply-chain after the occurrence of a disruption, such as the Covid-19 pandemic. The outcome of this work will be a basis on which (HCSC) consisting of vital resources, such as PPE, medical equipment, ventilators, and healthcare professionals (HCP's), can be prepared to mitigate disruptions. This research investigates mitigation strategies and tools for their appropriate application to pandemic disruptions to avert shortages and delays. This has the potential to significantly benefit the healthcare industry, healthcare practitioners and the local community with a resilient and effective response, when experiencing a supply chain spike such as the Covid-19 Pandemic.

A conceptual model for Covid-19 vaccine distribution is developed using Vensim software. The model is used to analyze the current state for system deficiencies. Various scenarios of the supply chain are run using standalone mitigation strategies or in combinations to obtain an optimal framework for an improved system design to prepare for potential disruption.

ISBN: 97819384962-3-3