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Optimizing Cold Chain Management in Sri Lanka's Pharmaceutical Industry: A Fuzzy Logic Approach to Enhancing Transportation and Storage

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In the logistics industry, the cold chain system plays a major role in ensuring the quality and safety of temperature-sensitive products such as pharmaceutical items and other perishable goods (Vukašin et al., 2024). This study focused on analysing how to optimize Cold Chain Management (CCM) within Sri Lanka's private sector pharmaceutical industry with an emphasis on storage and transportation. Rout (2024) indicates that the high costs associated with the cold chain process, transportation and storage inefficiencies, lack of skilled professionals, and regulatory inconsistencies can hinder efficiency and complicate operations. The objective of the study was to analyse how to enhance the decision-making process and reduce product spoilage during storing and transporting functions while ensuring that medications reach patients in optimal condition and protect the merchantable quality. Through a comprehensive literature review, the key variables were identified, the use of the fuzzy logic framework was highlighted, and the challenges in maintaining the quality were addressed. The study contributes to the existing body of knowledge by applying this novel methodology which can be used by any developing country that has logistical challenges and other limitations. The findings give practical insights into the concerns of the decision-makers providing a blueprint focusing on travel time, packaging, skillful personnel, temperature maintenance, and infrastructure availability. The study couples two intangible benefits and identifies three extended benefit scales such as low, medium, and high. In conclusion, the effective use of fuzzy logic in enhancing CCM offers an adaptive and structured method for improving product quality and provides a valuable tool for improving the management of temperature-sensitive products.

Keywords: *Cold Chain Management (CCM), fuzzy logic, pharmaceuticals, transportation, storage, private sector*