

Severity Assessment of Delays in Medical Cold Chain Logistics

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Abstract

Medical cold chain logistics are essential for maintaining the quality and safety of temperature-sensitive healthcare products, particularly vaccines. However, vaccine supply chains remain vulnerable to delays that may compromise service reliability and product integrity. This study presents a qualitative assessment of delay sources and their perceived severity in the vaccine cold chain, using Thailand as a case study. Semi-structured interviews were conducted with key stakeholders involved in vaccine manufacturing, storage, transportation, and distribution. The interview data were analyzed using thematic coding to identify and classify major delay sources, complemented by a frequency analysis to examine the prominence of different delay categories. The results show that delays related to external disruptions and manufacturing processes were most frequently reported, followed by logistics and transportation delays and supply chain coordination failures. Interview narratives further indicate that delays associated with coordination failures, regulatory processes, and

temperature-control disruptions are perceived as particularly severe due to their cascading effects and heightened risks to vaccine quality. In addition, delays in the testing and inspection of raw materials and finished vaccines prior to hospital delivery were highlighted as critical issues, as prolonged testing periods can significantly reduce remaining shelf life and lead to batch rejection by healthcare providers. The findings provide practitioner-informed insights and a foundation for future quantitative severity assessment of vaccine cold chain delays.

Keywords

Medical cold chain logistics, Vaccine supply chain, Delays, Thailand.