Chapter 89 Improving Opportunities in Healthcare Supply Chain Processes via the Internet of Things and Blockchain Technology

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ABSTRACT

Despite key advances in healthcare informatics and management, little progress to address supply chain process-related problems has been made to date. Specifically, key healthcare supply chain processes include product recalls, monitoring of product supply shortages, expiration, and counterfeits. Implementing and executing these processes in a trusted, secure, efficient, globally accessible and traceable manner is challenging due to the fragmented nature of the healthcare supply chain, which is prone to systemic errors and redundant efforts that may compromise patient safety and impact health outcomes adversely. Blockchain, combined with the Internet of things (IoT), is an emerging technology that can offer a practical solution to these challenges. Accordingly, IoT blockchain offers a superior way to track and trace products via a peer-to-peer distributed, secure, and shared ledger of the blockchain network. This article highlights key challenges related to healthcare supply chains, and illustrates how IoT blockchain technologies can play a role in overcoming these challenges now and in the near future.

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1. INTRODUCTION

In health care, supply chain management (SCM) and related activities constitute the second largest pool of expenditure (Scalise, 2005, Kowalski, 2009). The broad scope of healthcare SCM operations includes on-time delivery and tracking of items across the supply chain (SC) until its intended use with patients. Past studies in retail and manufacturing had quantified the strategic and competitive benefits of an efficient SCM; yet, capitalizing on these benefits remains elusive for healthcare provider organizations. McKone-Sweet et al. (2005) identify several critical barriers in implementing effective SCM solutions for health care that include misaligned or conflicting incentives, the need for better data collection and performance metrics, the limited education about SC issues and potential conflicts among group purchasing organizations and other SC partners. Further exacerbating the problems in healthcare SC concerns the use of disparate information systems (IS) and software with limited interoperability. Consequently, the current inefficient, manual and ad hoc practice for product tracking-traceability presents a compeling case to embrace automated technology and machine learning solutions.

To date, a large body of healthcare SC literature emphasizes the need for more integrated information technology (IT) and synchronized electronic data interchange (EDI) systems for enhanced product visibility and traceability. Ford & Scanlon (2006), for example, argue how applications of effective SC methodologies can contribute to increased quality and cost controls in healthcare purchasing. Landry & Philippe (2004) highlight the need for hospital systems to better integrate logistics activities via reengineering and activity-based costing. Landry & Beaulieu (2013) further unveil the challenges and complexities in hospital internal SCM. De Vries (2011) points to the existence of multiple goals among stakeholders in health care that strongly influence inventory-based decisions. Privett & Gonsalvez (2014) identify and prioritize significant global pharmaceutical SC challenges such as the lack of key player coordination, vulnerable warehouse inventory and order management, missing product demand information, improper temperature control during product transport and storage, the need for shipment visibility, information disconnect and inadequate tracking to avoid product shortage and expiration, and human resource (HR) dependency.

Today, resulting system-wide inefficiencies, interoperability issues, and data disconnect across the healthcare systems are dominated by the lack of a trusted data-sharing platform. This entails a need to improve how data are exchanged, stored and shared across multiple systems and stakeholders. The swelling cost of healthcare products and services makes a compelling case to adopt innovative technologies. Critical processes in the healthcare SC include product recalls, monitoring for product expiration, shortages and counterfeits – tracking these processes are cumbersome due to the lack of visibility, loosely integrated logistics and siloed IS/IT. Given that multiple stakeholders are involved in managing healthcare SC processes, IoT blockchain technology can offer a highly efficient way to track products from the raw material source to the point of actual consumption via a peer-to-peer (P2P) distributed, secure, and shared ledger system. The architecture and standards employed in IoT blockchain technology have a huge potential to improve product traceability and visibility, thereby enhancing the process of managing recalls, expiration, shortages and counterfeits throughout the healthcare SC.

IoT blockchain solutions to healthcare problems can be difficult to scope. Accordingly, this paper focuses on the role of IoT-based blockchains in improving and addressing key challenges in healthcare product management; specifically, managing SC processes dealing with product recalls, expiration, supply or item shortages, and counterfeits. Here, existing information and product flow in managing these processes are first reviewed. Drawing upon current inefficiencies and shortcomings, an IoT blockchain

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