Chapter 14
Enhancing Medication Traceability:
Advancements in Pharmaceutical Supply Chain Traceability Through Blockchain and IoT

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ABSTRACT

The surge in counterfeit drugs threatens global health and safety through pharmaceutical supply chains. This chapter delves into medication traceability, scrutinizing emerging technologies like RFID, IoT, and blockchain to tackle this issue. Despite interest in supply chain management and blockchain, challenges persist with data privacy, transparency, and authenticity in traditional track-and-trace systems. Blockchain emerges as a decentralized solution, enhancing traceability with smart contracts that ensure data authenticity, sidestep intermediaries, and maintain an immutable transaction record. Integrating blockchain can curb fraud, optimize inventory, cut courier costs, build stakeholder trust, and expedite issue identification. Stressing robust traceability, the researcher is continuously monitoring for environmental and economic gains. In this chapter, the authors have augmented existing literature by empirically assessing blockchain's qualitative attributes in pharmaceutical supply chains, suggesting improved system integration and a broader scope for future endeavors.

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1. INTRODUCTION

The pharmaceutical industry encompasses the activities of researching, conducting processes, and organizing efforts to discover, manufacture, distribute, and develop pharmaceutical preparations or drugs. As per the World Health Organization (WHO), a pharmaceutical formulation or drug refers to any substance or blend of substances that is produced, sold, marketed, or claimed to be used for diagnosing, treating, reducing the severity of, or avoiding diseases, Unusual physical states or the signs of these conditions in humans or animals.

In the pharmaceutical sector, the pharmaceutical supply chain (PSC) is an intricate network comprising several autonomous entities such as providers of raw materials, producers, distributors, pharmacies, medical facilities, and patients (Shah, 2004). In earlier times, a good amount of return on investment and sales from "blockbuster" products contributed to high R&D efficiency, prolonged patent terms, barriers to technological entry, minimal product alternatives, and decreased sensitivity to pricing. The company's approach was to leverage price stability and channel about 25% of sales profits into R&D, ensuring a strong product lineup (Booth, 1999). However, recent circumstances present more challenges. To accomplish the primary objectives of the medical sector, the Food and Drug Administration (FDA) and individual states oversee the business by implementing legislation and administrative directives that aim to safeguard the quality of medications across the PSC. Millions of information are necessary to store and document the movement of pharmaceuticals from production to use, as mandated by these laws and regulations (Mitchell, 1998). The documentation procedure inherently includes the administrative obligation to do track and trace. This serves as the basis for enhancing the safety of patients by providing manufacturers, distributors, and pharmacies with a systematic approach to identify as well as regulate drug diversion, counterfeiting, and mistreatment. Tracking supply within this network is complex due to several reasons such as limited information, centralized control, and conflicting behavior among stakeholders. The intricate nature of the problem not only leads to inefficiencies but also exacerbates the difficulty of preventing counterfeit pharmaceuticals from infiltrating the supply chain of healthcare. Figure 1 depicts a standard approach for distributing drugs in a supply chain (Musamih et al., 2021).

Figure 1. Stakeholders in the Drug Supply Chain and Their Interconnections