# Integrating Auditing and Inspection into Metaverse-Based Healthcare and Pharmaceutical Supply Chains

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*Abstract*—**Metaverse-based healthcare and pharmaceutical supply chains aim to enhance operations by providing greater visibility, virtual representations of facilities and material flows, and innovative methods for coordination and training. However, these metaverse-based systems largely overlook critical regulatory functions, such as auditing and inspection. Audit planning, evidence review, and deviation assessment remain only loosely integrated with the live data streams and digital twin models available on these platforms. Consequently, risk oversight continues to be episodic and reactive, rather than continuous and proactive. To address this gap, we propose an architecture specifically designed to integrate auditing and inspection into metaverse-based healthcare and pharmaceutical supply chain environments. We integrate heterogeneous operational and sensor data with edge and cloud services, an analytics engine, and an immersive metaverse platform hosting interactive digital-twin models of facilities, logistics assets, and processes. We build on this infrastructure with a data lifecycle model supported by three algorithms for data collection, preprocessing, and analysis and risk assessment, enabling compliance-oriented monitoring and prioritization of anomalies and potential non-compliance events. We also consider constraints affecting metaverse-based audits, including technical limitations (i.e., connectivity, latency, device capabilities, and integration), regulatory requirements (i.e., data integrity, audit trails, and validation), and adoption and ethical considerations (i.e., training, human factors, privacy, and trust). Overall, we provide a structured blueprint for future implementations and empirical studies of immersive and data-driven audits in regulated metaverse-based healthcare and pharmaceutical supply chains.**

*Keyword*—**Audit, Healthcare, Immersive Environment, Inspection, Metaverse, Supply Chain**

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