WJPMR, 2026, 12(6), 233-235

Research Article

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Impact Factor: 7.555

ISSN (O): 2455-3301

ISSN (P): 3051-2557

Coden USA: WJPMBB

EMERGING ROLE OF NFTS IN HEALTHCARE AND PHARMACEUTICAL INDUSTRY

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DOI: https://doi.org/10.5281/zenodo.20455705

How to cite this Article: Jyoti*, Sakshi, Aashima, Riya. (2026). Emerging Role of Nfts In Healthcare And Pharmaceutical Industry. World Journal of Pharmaceutical and Medical Research, 12(6), 233–235.

Article Received on 21/04/2026 **Article Revised on 11/05/2026** **Article Published on 01/06/2026**

ABSTRACT

Non-Fungible Tokens (NFTs) are unique digital assets built on blockchain technology that can represent ownership of data or digital items. Although widely associated with digital art and collectibles, NFTs are increasingly being explored for healthcare applications.[1] This review examines how NFTs could be used in managing health data, improving supply chains, enabling secure identities, and supporting emerging digital health services. While NFTs show promise in enhancing transparency, security, and patient control, their adoption is still limited due to technical, regulatory, and ethical challenges.[2]

KEYWORDS: Non-Fungible Tokens, Blockchain, Data security, Privacy protection.

1. INTRODUCTION

Healthcare systems generate vast amounts of sensitive data, including medical records, diagnostic results, and treatment histories. Managing this data securely while ensuring accessibility remains a major challenge.[3] Traditional systems are often centralized, making them vulnerable to data breaches and inefficiencies.

Blockchain technology has emerged as a potential solution by offering decentralized and secure data management.[4] NFTs, a specialized form of blockchain asset, provide a way to assign unique ownership to digital items, which can be applied in healthcare systems.[1]

2. BACKGROUND

2.1 What are NFTs?

NFTs are digital tokens that represent unique assets. Unlike cryptocurrencies such as Bitcoin, which are interchangeable, each NFT is distinct and cannot be replaced by another.[5]

2.2 Blockchain in Healthcare

Blockchain is a decentralized ledger that records transactions securely and transparently. In healthcare, it has been proposed for electronic health records, drug supply tracking, and data sharing across institutions.[4]

3. METHODOLOGY

This review is based on an analysis of existing studies on NFTs in healthcare. Relevant articles were identified from academic databases and screened for relevance. Due to the emerging nature of the topic, only a limited number of studies were available for inclusion.[1]

4. APPLICATIONS OF NFTS IN HEALTHCARE

4.1 Patient Centric Data Management

NFTs can represent ownership of patient medical records, allowing individuals to control access to their data.[6] This improves privacy and enables secure sharing with healthcare providers. Medical records are important for diagnosis but are often stored in one hospital only. This makes it difficult to access records in emergencies or when changing hospitals. Sometimes data is shared without patient permission, causing privacy issues.

Role of NFTs in Patient Data

1. Patients have full ownership of their data
2. Data is encrypted and secure
3. Easy sharing with doctors and hospitals
4. Data sharing only with patient consent[7]

4.2 Medical Supply Chain

NFTs can help track medicines and vaccines, ensuring authenticity and reducing counterfeit products.[6] Managing medicines and medical equipment in healthcare systems is challenging due to limited visibility

and lack of transparency. Hospitals and suppliers often do not have accurate stock information, which leads to poor cost management and wastage.

During COVID-19, shortages and poor tracking systems made supply management more difficult

1. Poor visibility of stock levels
2. Lack of transparency in tracking
3. Counterfeit drugs and equipment
4. Weak accountability.[8]

Role of NFTs in Supply Chain

NFTs help improve supply chain efficiency by providing secure and transparent tracking.

1. End-to-end tracking of medical products
2. Secure and tamper-proof data
3. Transparency in transactions
4. Detection of fake products
5. Permanent record of activities.[9]

4.3 Digital Twins

NFTs can provide secure digital identities for patients, which can be used across multiple healthcare platforms.[2] A digital twin is a virtual representation of a real object or system that uses real-time data for analysis. With increasing digital data, security and accuracy are very important. Blockchain and NFTs help in keeping data secure and prevent manipulation.

Role of NFTs in Digital Twins

NFTs convert real medical assets into digital form and store all activities and interactions securely.[10]

4.4 Clinical Trials and Research

NFTs can improve transparency in clinical trials by securely tracking participant data and ensuring data integrity.[7] Clinical trials test new drugs and treatments on humans. Challenges include lack of awareness, low transparency, and complex consent processes.

Role of NFTs in Clinical Trials

1. Secure storage of patient consent
2. Tamper-proof and verifiable records
3. Improved transparency and trust
4. Reduced time and cost[11]

4.5 Healthcare Data Monetization

NFTs allow patients to control and earn value from their health data. Patient data is linked to NFTs, giving ownership and control.

1. Patients own their data
2. Permission required for data usage
3. Patients can receive rewards or payment[12]

5. Advantages of NFTs in Healthcare

1. Clear ownership proof
2. No need for intermediaries
3. Automatic royalty payments
4. Easy monetization
5. Shared ownership
6. Authenticity and trust
7. Transparency and tracking
8. New market opportunities[13]

6. Challenges of NFTs

1. Copyright problems
2. Difficulty enforcing rights
3. Low adoption
4. Technical complexity
5. Environmental concerns
6. High cost
7. Lack of regulations
8. Legal uncertainty
9. Market risk[14]

7. Future Prospects of NFTs in healthcare

Future research should focus on real-world implementation, system integration, and regulatory frameworks. Improvements in scalability and efficiency will also be necessary.

NFTs play an important part in the future of digital healthcare in hospitals and medicinal diligence. By perfecting security, translucency, and effectiveness of the health care system. As digital technology is growing, NFTs can help in erecting a ultramodern and patient-centered health care system.[15] Its main idea is to make digital effects unique and precious, just like real-world particulars similar as oils or collectibles.[16]

Common Points

1. Future NFTs will combine with artificial intelligence, the metaverse, and stoked reality. This will produce further interactive and precious digital means.
2. NFTs works as a blockchain, due to which they help with translucency, trust in online deals, and security.[16]
3. NFTs will play an important part in developing new profitable systems by developing commemorative-grounded husbandry, where druggies can earn and spend digital commemoratives.
4. Non-fungible token will also help in growth of digital power and intellectual property.[17]
5. It will improve security mechanism by making focus on security solutions like revocable signatures and also develop cryptographic technique to reduce misuse and fraud.[18]

8. CONCLUSION

Non-fungible commemoratives(NFTs) play a grater role in transfoming the healthcare and pharmaceutical sectors. By using block chain technology, NFTs can healp cover sensitive health information and reduce the threat of data abuse. They play important part in tracking drug and precluding the rotation of fake medicines, icing patient safety. still despite of all these advantages there are several challenges similar as specialized knowledge, legal and ethical enterprises, so proper mindfulness, specialized development are needed. Overall, NFTs give

promisinf future in healthcare. They can make healthcare systems more effective, secure and patient centrerd, contributing better health issues worldwide.

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