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NUVORA: A TRUSTWORTHY AI FRAMEWORK FOR INTEGRATED DIGITAL HEALTH AND PATIENT WELL-BEING

NUVORA: UN MARCO DE IA FIABLE PARA LA SALUD DIGITAL INTEGRADA Y EL BIENESTAR DE LOS PACIENTES

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Abstract: The rising prevalence of chronic diseases and polypharmacy presents clinical, economic, and ethical challenges to healthcare systems. Patients face fragmented pharmacological treatment management, financial constraints, and limited control over their health data. This paper presents Nuvora, a patient-centric digital health framework that integrates pharmacological and financial data through trustworthy artificial intelligence (AI) and blockchain-based governance. As a conceptual and architectural proposal derived from an innovation pitch, it emphasizes design principles, system architecture, and ethical foundations with-out empirical validation. The framework aims to support informed decision-making, improve treatment adherence, and enhance patient autonomy, aligning with European regulations on trustworthy AI and data protection.

Keywords: digital health; trustworthy ai; polypharmacy; patient-centric systems; blockchain; health data governance.

Resumen: El aumento de la prevalencia de las enfermedades crónicas y la polifarmacia plantea retos clínicos, económicos y éticos a los sistemas sanitarios. Los pacientes se enfrentan a una gestión fragmentada del tratamiento farmacológico, a restricciones económicas y a un control limitado sobre sus datos sanitarios. Este artículo presenta Nuvora, un marco de salud digital centrado en el paciente que integra datos farmacológicos y financieros mediante inteligencia artificial (IA) fiable y una gobernanza basada en *blockchain*. Como propuesta conceptual y arquitectónica derivada de una presentación de innovación, hace hincapié en los principios de diseño, la arquitectura del sistema y los fundamentos éticos sin validación empírica. El marco tiene como objetivo apoyar la toma de decisiones informadas, mejorar el cumplimiento del tratamiento y potenciar la autonomía del paciente, en consonancia con la normativa europea sobre IA fiable y protección de datos.

Palabras clave: salud digital; IA fiable; polifarmacia; sistemas centrados en el paciente; cadena de bloques; gobernanza de los datos sanitarios.

1. INTRODUCTION

Chronic diseases and polypharmacy represent a growing burden for healthcare systems worldwide [1-3]. Patients managing multiple long-term treatments often encounter fragmented care, limited coordination between healthcare providers, and insufficient tools to understand both the clinical and financial implications of their therapies. These challenges increase the risk of medication non-adherence, adverse drug interactions, and financial stress, ultimately affecting patient outcomes and quality of life.

Digital health solutions have emerged to address parts of these issues, such as medication reminders, telemedicine platforms, or financial health applications [4]. However, most existing tools remain siloed, focusing either on clinical data or financial aspects, without providing an integrated, patient-controlled view. Moreover, the increasing use of artificial intelligence in health raises concerns related to transparency, bias, data privacy, and regulatory compliance.

This paper introduces Nuvora, a digital health framework designed to integrate pharmacological and financial data within a single patient-centric ecosystem. Nuvora is conceived as a trustworthy AI-enabled platform that empowers patients to better understand, manage, and optimize their treatment plans. The contribution of this work lies not in empirical validation, but in the structured presentation of the concept, architecture, and ethical foundations of the proposed system, aligned with current European regulatory and societal expectations.

2. NUVORA: CONCEPT AND ARCHITECTURE

2.1. Conceptual Overview

Nuvora is designed as a holistic digital companion for patients with chronic conditions and complex medication regimens. Its core objective is to support informed decision-making by combining health-related data with financial insights, placing the patient at the center of the system. Unlike traditional health applications, Nuvora does not aim to replace healthcare professionals but to complement clinical decision-making through personalized, transparent, and explainable recommendations.

The framework assumes that patient well-being is influenced not only by clinical factors but also by economic constraints and behavioral patterns. By addressing these dimensions simultaneously, Nuvora seeks to reduce treatment-related risks and enhance patient engagement.

2.2. Data Integration Layer

The system integrates heterogeneous data sources, including:

- Pharmacological data (prescriptions, dosage, treatment duration).
- Patient-reported information (adherence, side effects).
- Financial data related to medication costs and healthcare expenses.

Data integration is designed following privacy-by-design principles, ensuring that only the minimum necessary data are processed and that patients retain control over data access and sharing permissions.

2.3. AI-Driven Decision Support

Artificial intelligence within Nuvora is used to provide decision support rather than automated clinical decisions. The AI layer focuses on:

- Identifying potential risks related to polypharmacy.
- Detecting adherence patterns.
- Offering personalized alerts and recommendations.

The system emphasizes explainability, allowing users to understand the rationale behind recommendations. This approach aligns with the concept of trustworthy AI, prioritizing transparency, human oversight, and accountability over purely predictive performance.

2.4. Trust and Governance through Blockchain

To reinforce trust and data governance, Nuvora incorporates blockchain-based mechanisms for consent management and data traceability. Blockchain is not used for data storage but as a governance layer that records access permissions and consent transactions. This design enables auditable data flows and strengthens patient autonomy over personal health information.

3. TRUSTWORTHY AI AND ETHICAL DESIGN

Trustworthy AI is a foundational principle of the Nuvora framework. The system is designed in alignment with European ethical guidelines and emerging regulatory frameworks, particularly those addressing high-risk AI systems in healthcare. Key ethical considerations include:

- *Transparency:* AI-driven recommendations are explainable and accessible to users.
- *Privacy and Data Protection:* Compliance with data protection regulations is ensured through anonymization, access control, and decentralized governance.
- *Human Oversight:* Healthcare professionals remain central to clinical decision-making.
- *User Empowerment:* Patients can actively manage consent and data sharing preferences.

By embedding these principles into the system architecture, Nuvora aims to mitigate common risks associated with AI in healthcare, such as loss of trust, opaque decision-making, and data misuse.

4. DISCUSSION AND FUTURE WORK

As a conceptual framework derived from a pitch, Nuvora presents several strengths, including its integrated perspective on health and financial well-being and its emphasis on trustworthy AI. However, the approach also faces limitations. The absence of large-scale empirical validation and real-world pilots currently restricts claims regarding clinical effectiveness or economic impact.

Future work will focus on pilot studies in collaboration with healthcare institutions, technical validation of the AI components, and usability assessments with end users. These steps are essential to evaluate the practical feasibility and real-world benefits of the proposed framework.

5. CONCLUSIONS

This short paper has presented Nuvora as a patient-centric digital health framework that integrates pharmacological and financial data using trustworthy AI and blockchain-based governance. By translating an innovation pitch into an academic format, the paper highlights the conceptual and ethical foundations of the system rather than empirical outcomes. Nuvora contributes to ongoing discussions on integrated digital health solutions and underscores the importance of trust, transparency, and patient empowerment in the design of future healthcare technologies.

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