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Governance of Electronic Health Records based on archival techniques and Blockchain and Smart Contracts technologies

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Author's short biographies

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Claudio Gottschalg-Duque: has a degree in Modern Languages, with specialization in Portuguese and German, from the Faculty of Letters of the Federal University of Minas Gerais (1994), a master's degree in Psycholinguistics from the Graduate Program in Linguistic Studies at the Faculty of Letters of the University Federal University of Minas Gerais (1998), Sandwich Doctorate. in computational linguistics at Angewandte Sprachwissenschaft und Computerlinguist - Justus-Liebig-Universität Giessen (2003/2004), and Ph.D. in Information Production and Management at the Graduate Program in Information Science at the University's School of Information Science Federal of Minas Gerais (2005). Associate Professor at the School of Information Science at the University of Brasília (FCI-UnB), since 2006, and effective member of the Graduate Program in Information Science (PPGCINF/FCI-UNB), since 2007 and collaborator at the Federal University of Minas Gerais in the Graduate Program in Knowledge Management and Organization (PPGGOC) since 2022.

Tomás Roberto Cotta Orlandi: has a PhD degree in Information Science from UnB - University of Brasília / FCI - Faculty of Information Sciences, acting as a member of the research group R.E.G.I.I.M.E.N.T.O. - Information Architecture, Computational Linguistics and Multimodality, Media and Interactivity. Master in Knowledge Management and Information Technology from the Catholic University of Brasília (2002), Specialist in IT Governance from the University of Brasília - UNB (2007), Specialist in Software Engineering from the Catholic University of Brasília (1990) and graduation in Technologist in Data Processing from the Catholic University of Brasília (1985). Senior Systems Analyst at Brazilian Postal Service, Correios - ECT. Professor of graduation in the areas of systems analysis. Postgraduate professor in the areas of Project Management, BSC focused on IT and Software Engineering.

Introduction

- This research addresses the importance of the Electronic Health Record (EHR) for Health 4.0, by advances provided by robotics, artificial intelligence, the Internet of Things, among other technologies, which together will work towards increasingly interconnected, efficient, and secure patient services.
- Recognizing EHR as an archivistic and digital archival document, the study is based on the premise that the application of archivist's methods, archival methods, Blockchain, and Smart Contracts can contribute to improving the management of these records.

The Literature Review

Information and the areas that study it:

- Information has been fundamental to the record of human existence and the transmission of knowledge since the dawn of civilization. Thanks to visionaries and pioneers, the Science of Information has advanced in ways to record, organize, classify, and disseminate information.

- As science progressed, various specialized areas emerged for dealing with books, documents, and other informational materials. Archival Science is one of these areas whose focus is on archival management of documents.

- The health field has a close relationship with Archival Science since it is both a producer and user of documents that can serve as evidence of facts and events, as well as being crucial for decision-making.

The Literature Review

Information Science:

- The field of Information Science (IS) is an interdisciplinary domain that relates to Information Technology, professional practice, and studies in the social and human areas (RONDINELLI, 2007).

- IS primarily focuses on the study of information, which is an essential part of modern life. This field seeks to understand the properties, flow, processing, and behavior of information to optimize its use and availability (BORKO, 1968).

The Literature Review

Blockchain and Smart Contracts:

- Blockchain is a technology considered secure, and its operation includes the use of hashes to control content, chronological records (timestamps), digital signatures, and verification of data authenticity through mining, described as a computational mathematical process (RODRIGUES, 2017).

- Smart Contracts “are a form of automated digital contract in which the terms of a transaction are embedded in computer code to be recognized by software upon a certain input” (SILVA, 2020, p. 27). They are developed with the security of Blockchain and make their applications more flexible to programming according to established business rules.

The Study

- With the advancement of “Health 4.0,” it is essential to integrate records management (RM) into its processes and products to optimize results through the provision of accurate and reliable data. In the era of the big data phenomenon, access to quality information will be as important and competitive advantage as the benefits of artificial intelligence and robotics.

- Records Management, combined with Blockchain and Smart Contracts technologies, is necessary to support the technological advancements of Electronic Health Records (EHR).

Research Question

- **How can archival management and Blockchain and Smart Contracts technologies positively contribute to the management of EHR?**

Methodology

- This research employs systematic literature review (SLR) methods, explores archivists and archival concepts, and analyzes the characteristics of Blockchain and Smart Contracts.

Methodology

- **Research Classification**: applied, exploratory, bibliographic, and qualitative.
- **Research Methodological Strategy**: systematic literature search on Blockchain, Smart Contracts, and related themes to Archivology and Electronic Health Records (EHR), in addition to the identification and selection of an appropriate process modeling notation.
- **Research Methodological Course**: from the choice of theme to the development of a method for archival management of EHR using Blockchain technologies and Smart Contracts.
- **Research Corpus**: systematic literature searches for scientific articles on the research theme in 7 databases.
- **Narrative Review**: to find articles associated with technical terms from Archivology.

Methodology

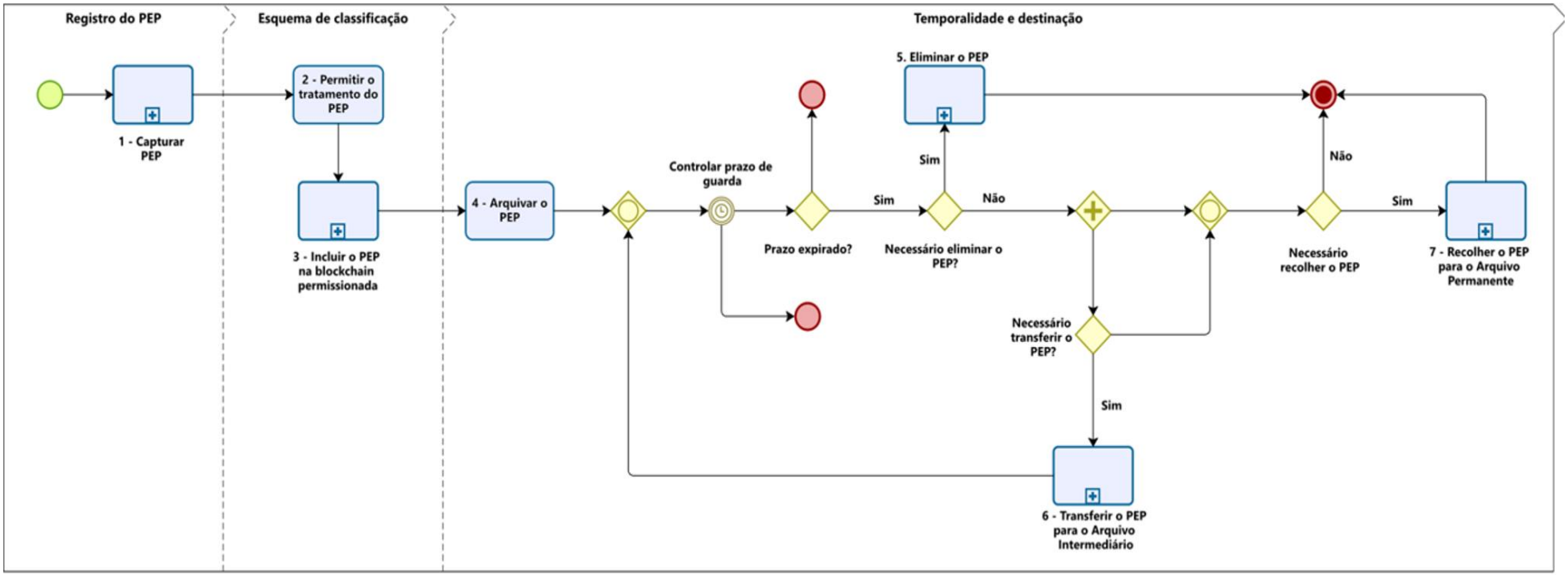
- A method was created for the archival management of EHRs using Blockchain and Smart Contracts, encompassing:

- Macroprocess: EHR Lifecycle:

- Process 1: Capture of the EHR;
- Process 2: Access and security classification scheme;
- Process 3: Include the EHR in a private (permissioned) Blockchain network;
- Process 4: Archiving the EHR;
- Process 5: Eliminate the EHR;
- Process 6: Transfer the EHR to the Intermediate Archive;
- Process 7: Collect the EHR for the Permanent Archive.

Methodology

Macroprocess: EHR Lifecycle



Source: XAVIER (2021, p. 117).

Results

- As a result, a method called ‘EHR Lifecycle’ was proposed, consisting of a macroprocess and subprocesses containing activities related to technical archivists and archival management with the use of Blockchain and Smart Contracts technologies for EHR management, as well as the implementation and monitoring of maturity levels in EHR governance.
- The applied and exploratory approach reveals the need for greater involvement of Archival Science archival professionals in studies related to document records management, using these technologies in the EHRs context, aiming to contribute to the advancement of this thematic field and with the emergence of ‘patient 4.0’.

Results

- **Blockchain and Smart Contracts for Interoperability and Security**: to ensure the security and interoperability of EHRs (Electronic Health Records).

- **Archival Management of EHRs**: for the curation of health records.

- **Requirements for SIGAD in the Certification of Electronic Health Record Systems**: an important measure to ensure compliance and quality in health document management.

Results

- Monitoring the maturity level in archival and technological management of EHRs: to assess progress and identify areas that require continuous improvement.

- Patient Empowerment 4.0: enabling greater control over their own health data, securely sharing information, and contributing to health research. This can result in more personalized and efficient medical care.

Discussion

- Proposal for Classification Code and Schedule of Retention and Disposal of Reference Documents for the Health Sector.

- Review of retention periods for imaging exam results aiming at saving space, financial, and technological resources.

Discussion

- Need for periodic evaluation of EHRs: creation of an Evaluation and Document Disposal Commission (CRPAD) to evaluate and dispose of EHRs.

- Implement processes, archival techniques, and technologies that ensure their governance, including organization, curation, security, interoperability, privacy, and a focus on better service delivery to patients.

- Importance of updating document management practices, considering the specific needs of the healthcare sector and technological advancements.

Implications

- This research points to a future scenario where the management of EHRs will be more efficient, secure, and patient-centered.

- The Archivist will play a fundamental role as the curator of these records, while Blockchain technology and Smart Contracts will offer innovative solutions to the challenges of security, artificial intelligence, and connectivity in Health 4.0.

Suggestions for Further Research

- It is proposed to apply the method through a prototype of an Archival Document Management System (SIGAD) developed using Blockchain, with the use of Smart Contracts, and interoperable with a Trusted Digital Archival Repository (RDC-Arq).

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