Journal of Integrated Information Management

Vol 10, No 1 (2025)

Jan-June 2025

ISSN: 2623 - 4629

Journal of Integrated Information & Management

e-Journal

Volume 10 - Number 1: Special Issue / Jan - Jun 2025
https://ejournals.epublishing.ekt.gr/index.php/jiim

Journal of Integrated Information Management

Vol. 10 – No 1: Special Issue
Jan – Jun 2025

ISSN 2623-4629 (on-line)

Publisher

Department of Archival, Library and Information Studies, School of Management, Economics and Social Sciences, University of West Attica

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Editorial message

Dear Colleagues,

JIIM is an international, multidisciplinary, blind, peer-reviewed electronic open-access journal that publishes research efforts on all aspects and issues regarding Information Science and Integrated Information Management. JIIM is the official journal of the Department of Archival, Library & Information Studies, University of West Attica (UNIWA), and it is available through the Greek National Documentation Centre (EKT) ePublishing platform for electronic journals: https://ejournals.epublishing.ekt.gr/index.php/jiim.

The current special issue entitled "Records and Archives. Certainties and Doubts in a Hybrid World" hosts seven research articles that offer a comprehensive examination about current developments in archival science, theoretical, methodological, and practical, archival acquisition, appraisal, description, documentation, and management to developing physical, digital, or hybrid collections, organizational or personal, social, legal or cultural archives.

The BioState project, a digital reconstruction of the careers of public officials in 19th-century Greece, is introduced by Chrysanthopoulos et al. in the opening of the special issue. Specifically, the implementation of a semantic relational database for archival documentation is presented, which expands the prosopographical database by reconstructing relevant administrative archives. The applied model enhances the “digital afterlife” of bureaucratic documentation by connecting it with historical persons and facts.

The Europeana historical archives setting is introduced by Christos Papaioannou. The digitization practices and the operational structure of this project are discussed, with emphasis on metadata heterogeneity, access restrictions, and authentication issues. The digitization and online delivery of European historical archives present unique opportunities for historical research, offering diverse narratives and the inclusion of marginalized communities.

Myrto Stamatopoulou presents an intriguing type of photographic archives, the post-mortem ones. In Greece, these photographs may be rare, but they can be found in museums and private collections, offering valuable insights into societal attitudes toward death, loss, grief, and reconciliation with ideals of beauty and eternity. Photos of family members, fellow citizens, prominent individuals, politicians, and even ecclesiastical figures have been preserved, creating archives valuable for historical research.

The intersection of archives and reading promotion, focusing on 20th-century Athens as seen by students of the Department of Archival, Library, and Information Studies, is discussed by Michailidis et al. Group discussions and open-ended questionnaires captured the responses and student perspectives. Reading historical literature alongside archival materials from the same era offers a deeper understanding of each period, including attitudes, behavioral patterns, and culture.

Blockchain technology sparked the revolution of cryptocurrency, but the decentralized ledgers, permanent storage of information in a secure and verifiable way within blocks of transactions, and key encryption together represent a system capable of storing any type of information, including archives. Still, when the blockchain was introduced, European Union authorities designed the General Data Protection Regulation (GDPR) without considering blockchain as an option for archive storage. Kareklas and Chaleplioglou discuss the incompatibilities between them and possible solutions.

Hospital archives represent a unique type of collection that highlights the importance of the host organization. The historical hospital archives reveal not only medical practices from the past but also cultural heritage information. Eginitio Hospital, a nursing institution specializing in neurology and psychiatry with over a century of continuous operation and significant social impact, maintains an impressive historical archive. Penelope Katsigianni discusses the digitization of the Eginitio Hospital historical patient archive from 1904 to 1955.

The current management of medical records through the application of disruptive computational technologies is discussed by Chaleplioglou and Tsolakidis. A comprehensive bibliographic search was conducted, yielding over 9,500 publications on the computational technologies employed in routine electronic medical records management, ranging from machine learning and natural language processing systems to computational medical image analysis, recurrent neural networks, and generative artificial intelligence, reflecting the latest trends in archival management.

Special Issue Editors

Professor **Georgios Giannakopoulos**, University of West Attica

Associate Professor **Emmanuel Drakakis**, Ionian University

Journal of Integrated Information Management electronic journal

Reassembling the Archive: Datafication and the Digital Afterlife of Early Public Officials in 19th-century Greece

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Article Info

Article history:

Received 29 April 2025

Received in revised form 20 May 2025

Accepted 12 June 2025

http://dx.doi.org/10.26265/jiim.v10i1.41266

Abstract:

Purpose — *This paper explores the epistemological implications of datafication in historical research through the case study of the BioState project, which digitally reconstructs the careers of early public officials in 19th-century Greece. The project demonstrates how archival traces are reassembled as structured data, creating an administrative archive that never existed in institutional form.*

Design/methodology/approach — *The study is based on the implementation of a semantic relational database using the Heurist platform, which models historical records as interconnected entities. Methodologically, the project integrates ontology-driven data modeling, archival documentation, and interpretive strategies to convert fragmentary sources into a coherent digital prosopographical system.*

Findings — *BioState highlights that datafication is not a neutral act of digitization but a performative reconstitution of historical meaning. The project reveals how archival traces, originally non-standardized and dispersed, are transformed into a queryable knowledge system.*

Originality/value — *This work contributes to digital historiography by advancing a theoretical and practical model for reconstituting absent or fragmented archives. It proposes that the digital archive should be seen not as a repository of the past but as a performative apparatus that enacts new forms of historical visibility. The concept of the "digital afterlife" is introduced to describe how bureaucratic traces acquire renewed significance within computational environments.*

Index Terms — Digital history, prosopography, archival hermeneutics, datafication, Greek public administration, digital humanities.

I. Introduction

The transformations of the digital archives and databases in historical research reflect not only technological advancements but also the methodological and epistemological reconfigurations brought about by the digital turn. As Ian Milligan highlights, the historian's research practice has undergone a radical shift: from searching in physical archives and taking notes in notebooks, it has moved to the mass collection of digital photographs, information retrieval through algorithms, and engagement with born-digital sources such as websites and social media archives [1]. Digitization of sources is not merely a technical process of transferring analogue material into digital form; rather, it is an act of selection, interpretation, and politics, as Gerben Zaagsma argues. Decisions about what is digitized, how it is documented, how it is made accessible, and under what conditions shape the field of historical knowledge and information [2].

At the same time, digital databases and analytical tools enable the reconstruction and redefinition of the archive. Stephen Robertson, drawing on the work of Janet Murray, describes the evolution of the digital archive from "additive forms" that merely replicate analog formats (such as digitized books or curated thematic collections) to dynamic, interactive environments that harness the capabilities of computational processing and data visualization [3]. Moreover, the transformation of the "document" into "data" raises critical issues of representation and interpretation: data are not "raw" but rather constructed; *capta*, as Johanna Drucker argues, resulting from acts of

The research project entitled "Biographing the State: Digital Prosopography of the Modern Greek Public Administration (19th c.)" is implemented in the framework of H.F.R.I call "Basic research Financing (Horizontal support of all Sciences)" under the National Recovery and Resilience Plan "Greece 2.0" funded by the European Union–NextGenerationEU (H.F.R.I. Project Number: 15056).

selection and abstraction on the part of the historian [3, p. 89, 20, 21]. Technological infrastructures are not neutral; they inscribe assumptions and shape interpretive possibilities, thus making digital hermeneutics essential, one that critically reflects on the practices of digitization, documentation, and analysis [4].

The digital turn in historiography has led to a radical redefinition of the archive concept, transforming digitization from a technical act of preservation into a deeply performative practice of historical reconstruction [5]. Datafication refers to the transformation of historical information into structured, machine-readable data, producing a new "digital life" for traces and documents that were once dispersed, fragmented, or even non-existent in physical form. This shift does not merely concern the management or accessibility of sources; it reconfigures the very methodology of historical inquiry and redefines its object [6].

This paper examines the performative dimensions of datafication through the example of the research project entitled “Biographing the State: Digital Prosopography of the Modern Greek Public Administration (19th c.)” (BioState). The project creates digital records for the first public officials of the newly established Greek state, converting fragmented information from diverse archival sources into interconnected entities within a relational database. By employing the open-source collaborative web database service *Heurist* [7], the project does not merely document but effectively “invents” an archive that never previously existed as fond: a digital personnel file reconstructing the entire career trajectory of each official who staffed the Provisional Administration of Greece (1822-1827). It reconstructs the careers of individuals who served as public officials during this period, tracing their professional lives from their entry into service until their natural death.

The rapid development of digital prosopography in recent decades has profoundly transformed how collective historical actors are approached. Open access to data, interoperability, semantic linking, and the ability to perform multi-layered analyses have introduced new methodological and epistemological frameworks into historical research. At the same time, the adoption of conceptual models such as the *factoid approach* [8, p. 319, 9, p. 58-59] underscores the interpretative agency involved in structuring digital records and relational data.

Among the many internationally developed prosopographical databases in recent years, the following examples are especially indicative of the methodological and conceptual affinities shared with the present project: a. “The Database of Court Officers: 1660-1837”, which provides access to the career histories of every regularly remunerated officer and servant of the English royal household from 1660 to 1837 [10]; b. the “China Government Employee Database - (CGED-Q)”, which records all regular civil offices and their holders in the Chinese Empire during the Qing Dynasty (1760-1912) [11]. These projects are based on official records and registers for civil servants compiled by the administration. Similarly, in Greece, the only relevant research concerns the register of education officials in the 19th century, “People employed in Further, Secondary and Primary Education (19th c.)” based on the records of the Ministry of Education, research conducted two decades ago, making use of the digital capabilities and technology available at the time. [12].

In Greek Digital Humanities, it has also been used for prosopographical studies, mainly of social and political history. For instance, the project “Mapping Island Lives” [13] collects prosopographical information on persons who lived in the Ionian Islands (19th-20th centuries). Also, recently, Heurist has been used by members of the Institute of Historical Research of the National Hellenic Research Foundation to create the following prosopographical digital projects: “Prosopography of the Helleno-Venetian World” [14], which studies the persons who lived in the first Venetian colonies (13th century), “Representatives of the National Assemblies and Legislative. Biographical Documentation” [15], which documents the life of the political personnel of the 1821 Revolution and “Biographical Dictionary of Greek Members of Parliament, 1946-1956” [16], which attempts to examine the composition of the parliaments of the first post-war decade, through the compilation of a biographical dictionary of their members. Finally, the project “Cultural mediators between Greece, France and other European countries (1830-1974)” [17], focuses on the role of the intellectuals who contributed to the cultural development and modernization of Greece. To these initiatives may be added the contribution of the Centre for Research on Modern Greek History (KENI) and its Research Group for the Documentation and Study of the Greek Revolution and the Reign of King Otto (ETEMELEOP). Their project “LEXICON / 1833-1843” [18] focuses on the state officials of the period of the Absolute Monarchy, compiling structured biographical data on the administrative personnel of the early modern Greek state with a focus on the military. In a similar vein, though developed with different technological means, “Lexicon 1821” [19], produced by the same institution, comprises entries grounded in archival sources, as well as in primary and secondary literature. These entries are organized into three thematic categories: (a) individuals and social groups, (b) institutions, political bodies, assemblies, and diplomatic acts, and (c) land and naval conflicts, covering the period from 1821 to 1832.

The analysis of such projects requires simultaneous consideration of the technological capacities available at the time of their production, their funding frameworks, and their underlying research objectives. From a broader perspective, Lexicon 1821 and similar initiatives highlight the dynamic evolution of the field of digital history in Greece over the past three decades, reflecting the ongoing transformation in the relationship between historical research and digital technology.

What the BioState project uniquely contributes to this expanding landscape of prosopographical databases is its focus on the reconstruction of an administrative archive that never existed as such in institutional form. Unlike other projects that are based on pre-existing official registers or consolidated personnel files, BioState builds a digital infrastructure from fragmentary and heterogeneous archival sources, financial orders, official documents, digitized images of the officials' signatures, and marginal notes, which were not originally intended for biographical or administrative indexing. This process entails a double innovation: first, the historiographical reconstitution of bureaucratic memory during the formative years of the Greek state (1821-1832), and second, the semantic modeling of complex, historically contingent relationships between individuals, institutions, places, and administrative acts. By integrating dispersed traces into a coherent and queryable system, BioState not only recovers overlooked figures of state formation but also proposes a methodological framework for the interpretive reconstruction of absent archives in a digital environment. Ultimately, the project produces a corpus of approximately 300 model professional biographies, structured according to specific rules and formats. The analysis of these biographical data will yield insights into the social, economic, and educational profiles of the first employees of the modern Greek state. Moreover, their synthesis will allow for the reconstruction of the collective profile of the typical or ideal civil servant of the first half of the 19th century.

BioState brings to the forefront critical questions: Who constructs and assembles the archive in the digital horizon? Where do the boundaries lie between documentation and interpretation? How does the notion of testimony shift when the historical document is reconstituted as a data node? By examining the architecture, methodological choices, and interpretive tensions of the BioState, we propose a theoretical approach to the digital afterlife of bureaucratic traces; documents that were never organically or functionally produced as fonds yet become such within a digital regime of truth.

II. Reassembling the Archive: Theoretical Conception

The notion of *reassembling the archive* does not merely refer to a technical process of processing, indexation, and cataloguing records; rather, it entails a fundamental rearticulation of what we consider to be an "archive" and of its role in the production of historical knowledge. Digitization, particularly when combined with datafication, disrupts the foundational assumptions of archival stability and objectivity; the archive is no longer a set of material memory carriers, but a dynamic and constructed epistemic system [20].

Drawing on Lev Manovich's work on cultural analytics and the epistemology of data, we may understand digital archives as cultural interfaces, spaces where historical and bureaucratic knowledge is reorganized through the logics of computation, modularity, and algorithmic processing [21, 22]. In this light, projects like BioState function not simply as repositories but as engines of knowledge production, where meaning is generated through structured metadata, relational models, and data visualizations. This insight is echoed in Johanna Drucker's distinction between data and capta, the latter being "taken, not given," emphasizing that all data are the result of epistemic acts of selection, framing, and abstraction [23, 24]. Thus, visualizations of state bureaucracies and civil servant trajectories are not neutral outputs but epistemic performance forms of interpretive visualization that shape historical intelligibility.

The BioState project exemplifies these dynamics with remarkable clarity. By tracing the lives and careers of civil servants in 19th-century Greece, BioState does not simply recover a set of bureaucratic records, it reconfigures them into a structured, queryable, and analyzable system of historical knowledge. The project foregrounds the archival traces left by individuals who operated within and through the state apparatus, reconstructing the institutional logic and administrative frameworks of a formative period in the modern Greek state.

What is crucial here is that the archival status of these traces is not pre-existing but digitally produced. Personnel files, decrees, petitions, and reports are transformed into entities, attributes, and relations within a semantic data model. The record, in this context, acquires meaning through its position in a network, its connection to offices, roles, temporal intervals, and geographies. Visualization tools such as interactive maps and career graphs do not merely illustrate data; they enact new interpretive possibilities, allowing users to perceive patterns of mobility, institutional development, and political contingency. At the heart of BioState lies a conceptual shift: from the archive as a fixed repository to the archive as a dynamic field of historical reconstitution.

Theoretical challenges posed by the project demand a reflexive methodological posture. A digital archival hermeneutics must attend to the tools and frameworks it employs; ontologies, taxonomies, controlled vocabularies, and interfaces are not neutral instruments, but agents of meaning. Provenance, authority control, and data modeling practices must be critically examined, not only for their descriptive accuracy but for their historical and theoretical implications. In this light, the work of the digital historian or archivist is not merely technical but interpretive and curatorial. S/he does not recover the past, but remediates it, through selection, encoding, linking, and visual display. The result is not a reproduction of historical truth, but a reframing of historical possibilities within the logic of digital systems. BioState should not be understood simply as a prosopographical database, but as a historiographical intervention: an effort to construct an archival formation that was never institutionally consolidated, through the digital reconstitution of bureaucratic memory.

III. From Archive to Data: Datafication as a Form of Performance

The concept of datafication, the transformation of complex, interpretively rich historical information into standardized digital data, does not refer merely to the technical transcription of analog material into digital form. Rather, it represents a fundamental epistemological shift that affects how we perceive, structure, and interpret the past. Datafication constitutes a new form of historical performance. It is not a passive registration of "existing" information, but a dynamic incorporation of such information into a structured system of entities, categories, fields, and relationships [25, 26, 27]. Each piece of information: name, position, date, is transformed into a data entry, acquires identity through metadata, and becomes meaningful through its relations to other data points. Documentation does not precede organization; it is enacted through it.

The BioState project offers a paradigmatic example of the performative nature of datafication. At its core lies the construction of digital "personnel files" that never existed in physical form. This act is not merely restitutive but generative: it constructs a new grammar of historical representation through the normative registration of persons and acts.

The way this grammar is implemented is of critical importance. The selection of Heurist as the project's core infrastructure was deliberate: it is a platform that supports ontological modeling, that is, the definition of core entity categories (e.g., Person, Service, Institution, Document) and the specification of the relationships between them. Through this process, historical information becomes standardized and interconnected, enabling machine-based search, temporal and spatial visualization, statistical extraction, and automated mapping.

A central dimension of this process is the visibility and invisibility it produces. What does not fit into the predefined structures, what cannot be categorized or uniquely identified, is either omitted or relegated to the background. In this sense, datafication does not simply represent the archive; it reorganizes it according to its internal logic.

At the same time, through the creation of entities such as "Political Tenure," "Kinship Relations," "Place," "Administrative Act," and "Source," BioState captures a complex web of administrative and social interconnections. Civil servants do not appear as isolated individuals, but as nodes in a multilayered network of institutional, geographical, and temporal relationships. This constitutes a form of networked historiography that would not be feasible without the logic of datafication.

Yet the performative power of datafication also demands hermeneutic vigilance. As scholars of digital history have noted, data standardization is never a politically neutral act- it embeds conceptual assumptions, epistemological norms, and cultural hierarchies [28, 29]. What kinds of information are deemed "useful"? How is ambiguity recorded? What happens to the "noise" of history?

Data should be understood not as neutral carriers of historical fact, but as inherently interpretive constructions. Every act of normalization, abstraction, or encoding constitutes a hermeneutic intervention, shaping not only what is represented but how it becomes intelligible [30, 31]. This perspective is central to the methodological and epistemological premises of the BioState project. The creation of digital entities such as "Political Tenure," "Kinship Relations," or "Administrative Act" does not merely recover archival traces; it actively reconfigures them within a semantic framework that gives them coherence and analytical value. In doing so, BioState exemplifies the notion of *infrastructure as epistemology*: interpretive work does not reside solely in the content of historical data, but in the architecture of the system itself, the data model, the classification logics, and the interface design that make historical meaning possible.

At the same time, the process of datafication inevitably generates silences. Information that resists categorization, that carries ambiguity, or that does not easily map onto relational structures, tends to recede into the background or be omitted altogether. These absences are not trivial; they represent epistemic and ethical challenges that demand reflection. BioState addresses this through interpretive transparency, documenting the limits of data modeling and acknowledging the historiographical choices embedded in its design. Attending to these silences, what has been excluded, flattened, or rendered unreadable, is a crucial dimension of digital archival hermeneutics. It is through such critical engagements that digital historians and archivists can reclaim the interpretive complexity of the past within computational environments and resist the false objectivity that data structures may appear to promise.

The case of BioState shows that datafication, when accompanied by interpretive transparency and theoretical awareness, can become a tool for generating new historical meaning. The extraction of information from primary sources is not undertaken merely to retrieve documents, but to transform them into interrogable, comparable, and analytically meaningful objects of historical thought.

IV. The BioState Project: Methodology and Design Principles

During the initial phase of the project, a bibliographic database was developed using the Zotero platform to systematically record the relevant historiography and published sources used to document the biographical data of the individuals included in the research process. It also served as a referencing and documentation tool, supporting the processing of individual records, the management of citations, and the consistent handling of bibliographic metadata throughout all stages of the research workflow

The research project is based on the processing and indexing of archival sources that document the activities and official status of the first public servants of the Provisional Administration during the Greek Revolution. Central to this

process was the "Table of Financial Orders from the Ministry of Finance" [=Πίναξ χρηματικών διαταγών του Υπουργείου προς το Εθνικόν Ταμείον]» (ΚΡΑΚ 252), housed in the General State Archives (GSA) of Greece (Fig. 1), as well as the "Registry of the 3rd Political Department" [=Μητρώο του 3ου επί των Πολιτικών Τμήματος] from the Fighters' Archive of the National Library of Greece. Additionally, the Archive of the Administrative Committee (1826-1827), the Archive of the National Treasury (1822-1828), and the Executive Archive, all held at the GSA, were utilized. Important data were also drawn from the Archival Collections of the Greek War of Independence and the General Gazette, preserved in the Library of the Hellenic Parliament, as well as from the publications of the Government Gazette (FEK) of the National Printing Office. Despite their historical significance, these archival sources have received limited scholarly attention. Most of these materials have not been fully indexed, published, or integrated into broader historiographical narratives, especially concerning the institutional formation of the state and the bureaucratic constitution of authority during the Greek War of Independence. All archival material used in the study consists of official documents, that is, records produced by state institutions either for their internal administration or for informing the public. The BioState project addresses this gap by indexing, modeling, and recontextualizing these sources, thus rendering them accessible for the first time as research data.

The indexing of information from archival and literature sources forms the foundation of the project's research methodology and is crucial for transforming fragmented historical material into structured and interconnected data. The process begins with the systematic collection of records related to individuals who served in the public administration during the Provisional Administration. These sources were parsed into discrete informational units and recorded using an ontology-driven data collection form.

A central methodological principle was transforming fragmentary historical information into interconnected, searchable data. To achieve this, a relational database was designed and implemented within the Heurist environment, selected for its flexibility in supporting ontological modeling and its capacity to integrate heterogeneous types of sources (texts, documents, geographic references, and temporal data).

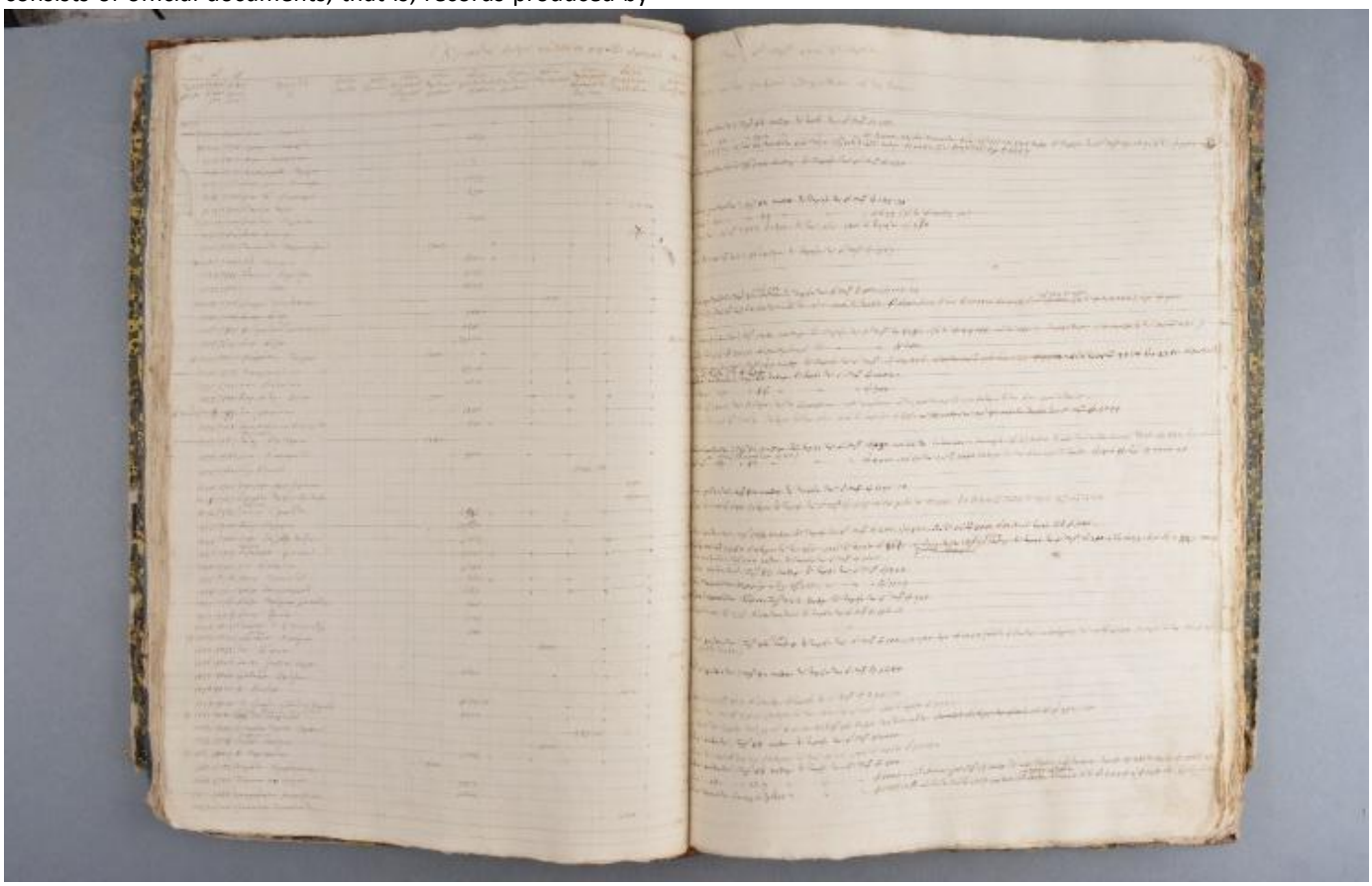

Figure 1. Representative pages from the document "Table of Financial Orders from the Ministry of Finance" (ΚΡΑΚ 252) © General State Archives (GSA) of Greece-Central Service Archives.

Within this framework, the core entities of the database were defined as follows:

- **Person** (as the central referential unit),
- **Institution** (the administrative body),
- **Service** (the relationship between person and institution),
- **Administrative Act** (e.g., appointment, dismissal),
- **Political Tenure** (involvement in formal or informal

political institutions),

- **Place** (geospatial information),
- **Source** (archival or literature documentation).

This structure enabled the semantic organization of data and facilitated advanced querying, historical visualization, and interpretive reconstruction of the early Greek state's bureaucratic landscape.

During the process of indexing historical information, the research team encountered considerable challenges stemming from the inherent fluidity and heterogeneity of the archival data. A particularly persistent issue was the high degree of variability in the rendering of personal names. The same individual frequently appeared across different sources under multiple orthographic variants, alternative spellings, or name forms influenced by toponymic attributions, familial epithets, or linguistic transformations (e.g., Hellenized or translated versions).

To systematically address this complexity, a standardized recording protocol was adopted. For each historical person of interest, a principal or canonical name form was defined, while all attested alternative versions were also documented and integrated into a structured *Name Thesaurus*. This approach enhanced the precision of name disambiguation and ensured the interoperability and retrievability of individual records across the corpus, regardless of the form under which a person appeared in the sources.

At the same time, temporal issues arose due to the use of both the Julian and Gregorian calendars in the sources, leading to ambiguities in dating official acts. The solution adopted was the dual recording of dates, aligning both calendar systems to ensure chronological precision and clarity in the documentation of events. Geographical identification is a crucial component in documenting the service trajectories of the first civil servants, as it enables the understanding of the spatial dimension of state operations. Within this framework, locations, places of origin, service, or transfer are recorded with precision and linked to the corresponding administrative acts. To enhance analysis and visualization, these locations are represented using cartographic data, allowing for the geospatial mapping of institutions and officials' movements. The database supports geographical referencing and visualization on digital maps, thereby facilitating the study of the spatial distribution of the state apparatus and the mobility patterns within 19th-century public administration.

The documentation of biographical information is a core pillar of the BioState project, as it directly supports the effort to understand the social and professional profiles of the early public officials. In this context, the full names of individuals are systematically recorded, along with alternative spellings, dates and places of birth and death, family relationships (spouses, children, etc.), and details about education, professional training, and intellectual background. The processing of this data helps shape their social profiles, reveal networks, and enables the interpretation of their roles in the process of state formation.

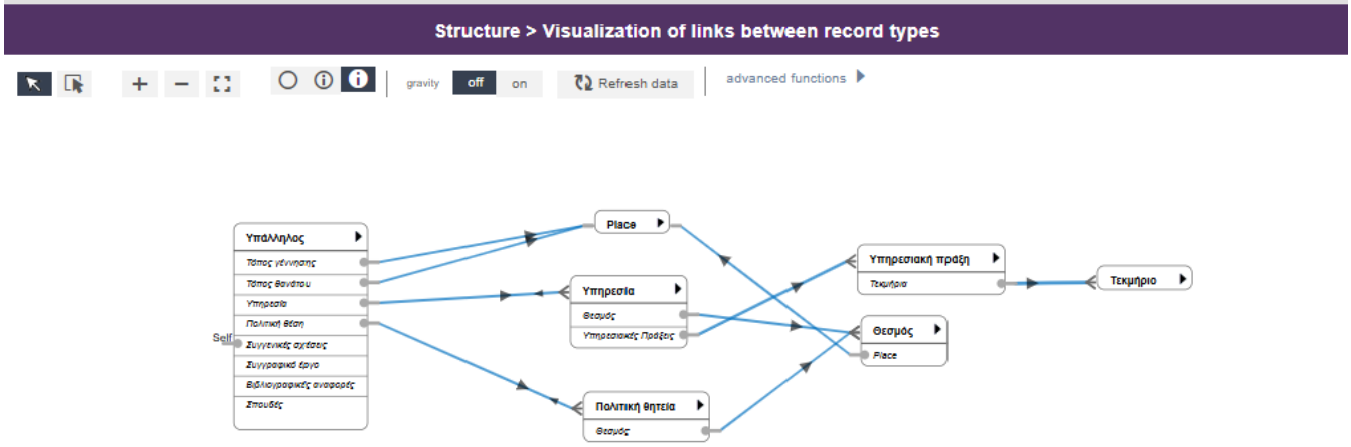

Figure 2. Ontological representation of the relationships between record types in the BioState project's relational database, as implemented within the Heurist system.

In parallel, a methodology for mapping the administrative careers of the officials is applied, aiming to link individuals to the institutions in which they served. Interconnected records are created, including the position held, the duration of service (start and end dates), and the administrative acts documenting their tenure (such as appointments, transfers, resignations, etc.). This information is linked to the respective institutions and their historical context, allowing for the tracking of administrative changes and the structure of public administration. This framework allows for addressing key research questions: tracing the administrative paths of individuals from the Provisional Administration to the established Greek State; reconstructing the internal organization of the first state services; and studying the evolution of public administration as an institutional mechanism. Moreover, this process leads to the development of specialized vocabularies that reflect the administrative terminology of the 19th century, offering valuable material for future research in the history of institutions.

The implementation of the project resulted in the generation of a structured, scalable, and semantically enriched digital profile for each historical subject, effectively a prosopographical record designed to support complex querying, cross-referencing, and analytical reuse across diverse scholarly workflows. The above visualization (Fig. 2) presents the structure of relationships between record types in the Heurist information environment, as implemented for the BioState project. This ontological representation reflects the core structure of data connections in the relational database, with the entity «Official» («Ypallilos») at its center, serving as the main carrier of information. The «Official» is linked to multiple other entities: to «Place» (place of birth and death); to «Service», which records the individual's tenure in a specific institution, including position and duration; to «Political Career», where applicable, capturing involvement in political or para-political institutions (e.g., the Filiki Etaireia); as well as to «Family Relations», «Education», «Authorship», and «Bibliographic References». The entity «Service» is in turn connected to the «Institution» in which the service took place, and to the corresponding «Administrative Act» (such as appointment, transfer, or resignation), which is documented by a «Source Record» (e.g., Government Gazette, archival records). Institutions are also linked to geographic data (the «Place» entity), allowing for the mapping of administrative activity. This visualization confirms the complex and interconnected nature of the project's data and highlights the functionality of Heurist as a tool for prosopographical documentation, enabling the integrated representation, retrieval, and analysis of information on 19th-century public administration.

The BioState methodology constitutes a hybrid framework, integrating archival source curation with ontology-driven data modeling. In this framework, each primary source fragment is formalized as a relational entity and embedded within a multi-layered, interoperable knowledge graph of persons, institutions, events, and locations (Fig. 3). This structure enables longitudinal tracking of individual careers, mapping of spatial and institutional mobility, detection of administrative patterns, and reconstruction of organizational continuities in the early Greek state-building process.

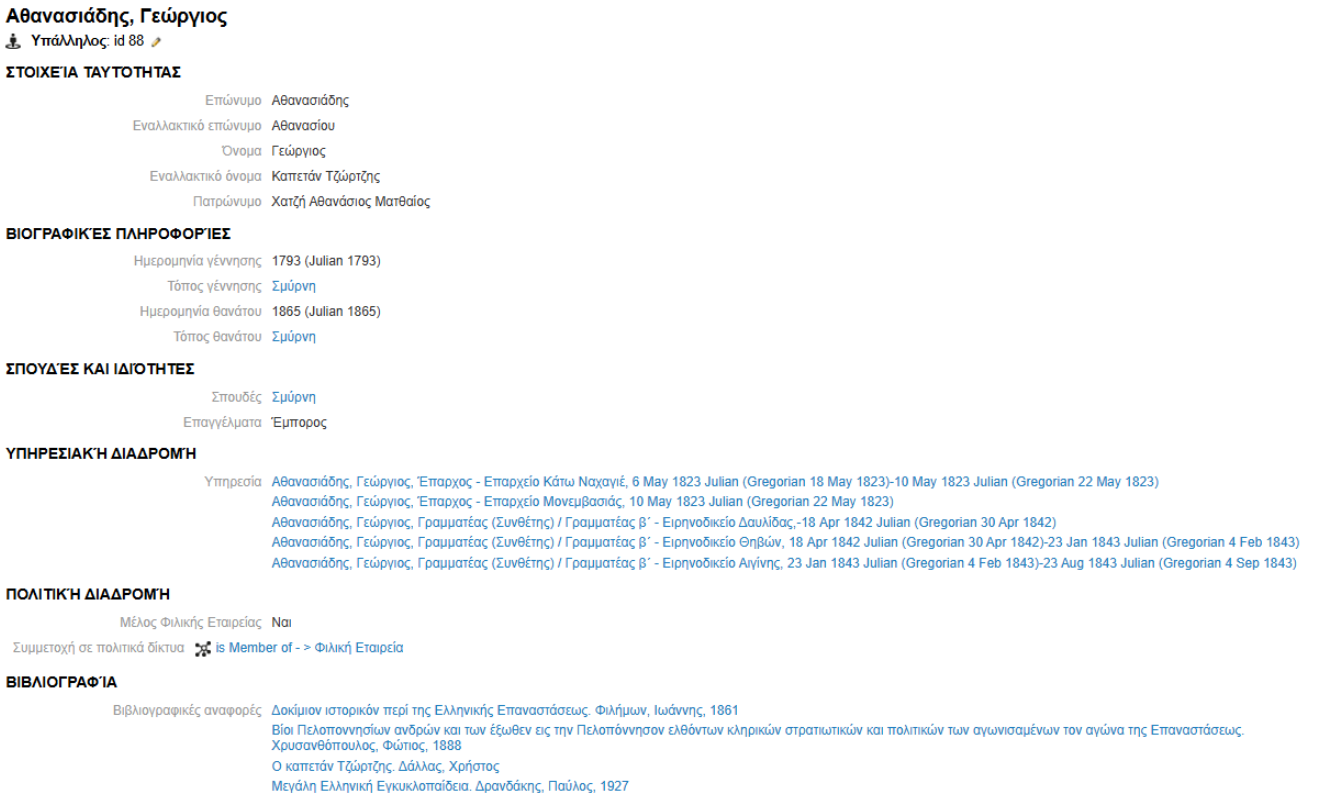

Figure 3. Example of a fully complete employee record in the Heurist information system for Georgios Athanasiadis. It includes identity details, biographical and educational information, a detailed timeline of public service positions with dates, references to political activity (member of the Filiki Eteria), and associated literature sources.

V. Interpretive Stakes and Representational Frameworks in the Digital Archive

As previously discussed, an archive is never merely a neutral repository of information; it is a system of representation that encodes choices about what is preserved, how it is structured, and how it becomes meaningful. In digital historiography, these representational dynamics are not diminished by technology, they are made more explicit. Digitization and datafication are not mechanical operations; they are interpretive practices shaped by conceptual frameworks, institutional priorities,

and design decisions [32, 33].

The BioState project exemplifies this complexity. Its core methodological move, the attribution of bureaucratic identity to historically marginal individuals, reflects a commitment to recovering overlooked dimensions of administrative memory. This is not simply a technical procedure; it is a gesture of recognition that gives structure and visibility to actors who were never institutionally acknowledged within conventional archives. In doing so, BioState reframes the early state not as an abstract institutional construct, but as a web of relations between named individuals, official roles, and evolving administrative structures.

This curatorial effort raises essential epistemological questions: Who defines the categories through which the past is made legible? What assumptions underlie the structure of the database? In digital archival environments, curation is not merely a logistical task, it is an act of interpretive modeling. In BioState, the design of entities, attributes, and relationships encodes a particular vision of how historical agency is organized and expressed. Any data model foregrounds certain dimensions of the past while leaving others less accessible or legible.

This becomes especially salient in cases of archival ambiguity, contradictory dates, partial identifications, or inconsistent naming conventions. Rather than flattening this complexity, BioState incorporates it through mechanisms that allow for uncertainty: multiple names, approximate dates, and vague geographical indicators. Such design choices reflect a methodological stance that treats uncertainty not as an error, but as a feature of the historical record requiring thoughtful representation.

Access to the digital archive also raises issues of usability and interpretive transparency. Although BioState is intended as an open-access public resource, the structuring of search pathways, the affordances of visualization tools, and the logic of data export all shape how historical knowledge is encountered and recombined. These interface dynamics function as interpretive filters, shaping what patterns are visible and what questions can be asked.

Moreover, digital archives and databases are not just an informational tool, it is a narrative space. Each interaction with the archive, every search, link, and visualization, constructs a micro-history. In this environment, the construction of historical meaning is no longer monopolized by academic historians; users themselves become active participants in generating interpretations, constructing trajectories, and discovering new perspectives.

The central interpretive challenge of the digital archive lies in its dual role: it preserves the past but also reconfigures it through the logic of its design. Projects like BioState do more than organize information; they contribute to the evolving imagination of statehood, authority, and historical agency. This contribution demands ongoing critical reflection; not only about what the archive contains, but about how it makes history possible.

In the context of this study, the term *digital afterlife* is not employed metaphorically, but rather analytically: it refers to the second, digital life of bureaucratic records whose original institutional function has ceased, but which acquire renewed meaning and purpose through their transformation into structured data. This constitutes performative survival, an expression of the archival trace's capacity to reappear in a new form, within a new environment, oriented by new questions and analytical frameworks.

The BioState project is a paradigmatic example of this transition. Records such as financial orders, administrative registers, or government gazettes, originally designed for strictly functional or procedural purposes, are reassembled as relational components within an administrative data infrastructure. A name listed in a payment ledger, a reference in an official bulletin, or a marginal note in a handwritten report is recontextualized as a digital entity: reframed as evidence of political tenure, as an indicator of geographic mobility, or as a data point in the professional trajectory of a public official.

This digital afterlife does not imply a revival of the past, but rather the construction of a new present of the past. Bureaucratic inscriptions are assigned a new ontological form: XML entries, database records, relational links, and geospatial visualizations. Interpretation does not merely follow the record; the record itself is already shaped by interpretation. Its inclusion in a database, its relational position, its classification, and its queryability are all forms of performative inscription enacted by the system.

This "second life" is also public. It is tied to access, reusability, analysis, and narrative recomposition. The historian engages with the system through multiple filters, geographical, institutional, temporal, or biographical, and can trace patterns, highlight deviations, and propose new narratives of state formation through the trajectories of individuals. These traces cease to be mere indicators; they become structural elements in the articulation of historical inquiry.

At the same time, this digital reconfiguration presents risks. Detaching a record from its original context may lead to false associations or over-interpretation; repurposing a document in new analytical settings can obscure its original meaning or flatten its archival specificity. The risk of illusory completeness, the impression that the database offers a coherent representation of a reality that was inherently fragmented, remains a persistent epistemological challenge.

Yet, when accompanied by hermeneutic awareness and theoretical reflexivity, the digital afterlife of bureaucratic traces can offer a radically new understanding of historical temporality, not as a linear sequence of events, but as a network of nodes, a system of relationships, a field of traceability. The archive, in this view, becomes a mechanism not for representing historical forms, but for detecting and reconstructing them.

In BioState, the memory of the first civil servants of the

Greek state is not merely revived, it is reconstituted. This reconstitution emerges through the convergence of historical research, archival documentation, and digital modeling. The past does not return as an image; it returns as structure.

VI. Conclusion

This paper has explored the epistemological, methodological, and representational implications of datafication and the digital reconstruction of archival records, focusing on the case of the BioState project. Rather than treating BioState simply as a technical instrument of digital documentation, it has been examined here as a performative intervention in the historiography of nineteenth-century Greek public administration, an effort to construct an archive that never historically existed, and to rearticulate the past through the relational logic of digital systems.

At the heart of this analysis lies the recognition that digital archival work is not merely representational, but constitutive of historical knowledge. The transformation of fragmentary documents, such as financial orders, decrees, and administrative notes, into structured, queryable data involves more than transcription or preservation; it entails the configuration of historical meaning through classification schemes, data modeling, and interface design. Within BioState, this process facilitates both the analytical reconstruction of state formation and the recovery of administrative actors and practices marginalized by official records and traditional historiography.

The project further exemplifies the interpretive force embedded in digital infrastructures. Every curatorial decision, regarding inclusion, data structure, and access, shapes a representational order through which the archival material becomes legible. BioState demonstrates that the digital archive does not operate as a neutral repository of facts but as a structured environment of meaning production, in which specific forms of historical visibility are enabled, while others remain constrained or obscured.

This reconfiguration of bureaucratic traces also generates what may be termed a digital afterlife: a second existence for archival materials, now circulating as data, integrated into new analytical constellations, and eliciting novel lines of historical inquiry. This recontextualization offers interpretive potential but also entails risks, decontextualization, semantic overreach, and the false appearance of completeness. These challenges call for a mode of digital hermeneutics grounded in methodological transparency, epistemic reflexivity, and historical attentiveness.

Ultimately, the BioState project calls for a rethinking of archival practice and research in the digital age, not as the passive transmission of the past, but as a generative space of epistemological and historiographical engagement [34, p. 114]. As digital infrastructures shape not only research tools but the very frameworks through which historical knowledge is produced, the archive and the research database emerge not as static repositories but as a dynamic, performative apparatus, one that actively structures, mediates, and transforms our understanding of the past.

Projects like BioState offer an important opportunity to bridge what Cook and Schwartz have termed *the archival divide*, the growing methodological and epistemological gap between historians and archivists in the digital age [35]. While in the nineteenth and much of the twentieth century the two fields were closely aligned in their concern for the preservation and interpretation of historical records, recent decades have witnessed a divergence: historians have increasingly adopted cultural and critical approaches, whereas archivists have turned toward the pragmatics of digital preservation and infrastructure. By integrating historical inquiry with digital archival design, BioState reanimates a shared space of collaboration. It engages both with the interpretive logics of the historian and the structural imperatives of archival organization, fostering a model of archival praxis in which metadata schemas, ontologies, and digital infrastructures serve not only as technical tools but as means of historical reasoning. In doing so, it demonstrates how digital prosopography can function as a cyberinfrastructural commons, reconnecting scholarly and archival expertise toward the co-production of historical knowledge.

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Journal of Integrated Information Management electronic journal

Historical Research in the Digital Age: Opportunities, Challenges, and Critical Reflections through the Case of Europeana

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Article Info

Article history:
Received 02 May 2025
Accepted 01 June 2025

http://dx.doi.org/10.26265/jiim.v10i1.41305

Abstract:

Purpose - *This study explores the impact of digitization on access to and use of historical archives, with emphasis on both the opportunities and the challenges it presents. Through a focused case study of Europeana, the European Union's flagship digital cultural heritage platform, the paper highlights how digitization has transformed the ways in which archives are collected, organized, and researched. However, this process is far from neutral, raising critical questions regarding historical interpretation and representation.*

Design/methodology/approach *- The article adopts a qualitative analysis of the operational structure and practices of Europeana. It examines the opportunities digitization creates for historical research, as well as the constraints and challenges associated with metadata quality, copyright restrictions, authenticity, and cultural representation.*

Findings - *While digitization expands access to historical records and opens new avenues for research, it also introduces persistent challenges. Metadata heterogeneity, restricted access, and issues of authenticity remain significant obstacles. Europeana emerges as an ambitious initiative with both strengths and limitations.*

Originality/value *- This study contributes to a deeper understanding of the complexities of digital archival access and emphasizes the need for critical engagement, transparency, and ethical responsibility. It underscores the importance of improving metadata quality, enhancing interoperability, and promoting inclusion within digital archives.*

Index Terms — Archival Digitization, Europeana, Historical Archives, Digital History

I. INTRODUCTION

The digitization of archival collections represents one of the most radical developments in archival science over recent decades. Since the 1990s, the rapid advancement of digital technologies has enabled not only the storage and preservation of documents in digital form but also their wide dissemination through online platforms on a global scale. Digitization has fundamentally reshaped the way the past is collected, organized, presented, and ultimately studied, creating new dynamics as well as challenges in the relationship between archival evidence and historical narrative [1].

Access to historical archives remains essential for the development of historical scholarship. Archival materials—both physical and digital—constitute the fundamental raw material for the production of historical knowledge. The possibility of immediate and unrestricted access to archival collections strengthens the democratization of historical research by facilitating broader public engagement with primary sources. Moreover, digital access transforms the nature of historical inquiry by enabling large-scale data analysis and interconnections across collections [1].

However, the digitization of archives is not a neutral process. Decisions regarding which materials are digitized, how they are described, and how they are presented shape historical perception and carry the risk of exclusion or distortion of memory. Descriptive practices and the choice of metadata function as interpretive acts that determine which experiences become visible and which are marginalized [2]. Archival infrastructures, even unintentionally, may reinforce the invisibility of certain social groups, thereby influencing the construction of historical memory. The digitization and description of archival records are, in essence, historiographical processes, while the use of metadata serves as a fundamental component of contemporary historical storytelling [3]. The development of a critical "archival consciousness" is thus essential in the present era [4].

Various initiatives have attempted to address these complexities in practice. *Europeana* is a prominent example of such an initiative. Created in 2008 by the European Commission, it aims to aggregate and publicly disseminate digitized cultural content from thousands of institutions across Europe by providing access to millions of items—from photographs and documents to works of art. It offers a powerful basis for understanding both the potential and limitations of digital historical research [5].

II. FRAMEWORK FOR UNDERSTANDING DIGITAL ARCHIVAL PRACTICES

The digitization of historical archives involves creating digital representations of physical records with the aim of preserving them, enabling their dissemination, and facilitating access to their content [6]. This process includes not only scanning or photographing objects, but also developing related metadata that describe, classify, and organize the digitized material in ways that are functional for both researchers and the general public. Digitization does not merely transfer the record into another format; it fundamentally alters the way records are perceived, searched, and analyzed, creating new opportunities as well as new challenges for historical study. Digital representation reshapes the connection between a record and its historical context, while the loss of its physical materiality introduces interpretive demands that are not always apparent to the user [1].

A central component of digital archives is the development and management of metadata. Metadata—the information that describes the content, structure, and context of a record—are crucial for effective access to and use of digitized collections. Without high-quality and consistent metadata, archival records become effectively invisible or dysfunctional for users, while the understanding of their provenance, authenticity, and contextual significance is compromised. Documentation requires a systematic approach that incorporates interoperable standards, multilingual normalization, and a clear definition of the entities related to the record [6].

The creation and application of metadata is neither a neutral nor a purely technical process. Archival description operates as a narrative act, in which the choice of terms, the prioritization of information, and the emphasis on certain features influence how the material is interpreted. Metadata therefore do not merely describe; they co-construct the meaning of the record. Access depends not only on technical availability but also on the social and cultural recognition of historical memory, which is often constrained by the absence or poor quality of documentation. Acts of selection, classification, and naming are interpretive in nature, revealing metadata structures as carriers of power and cultural orientation [7].

The theoretical framework emerging from these approaches highlights that the evaluation of digital archival platforms, such as Europeana, must focus not only on the quantity of available material, but also on the quality and structure of metadata practices that facilitate—or hinder—access and historical understanding.

III. EUROPEANA AND THE RESHAPING OF HISTORICAL ACCESS IN THE DIGITAL ERA

Europeana is widely recognized as one of the most significant initiatives for the digitization and dissemination of cultural and historical heritage at both European and international levels. It was established in 2008 as an initiative of the European Commission, aiming to aggregate and provide open access to digitized content from museums, libraries, archives, and cultural institutions across EU member states. As the official European hub for cultural heritage, *Europeana* supports the digital transformation of the sector by providing access to cultural data and promoting innovation in education, research, and the creative industries [5].

Today, *Europeana* operates as a digital portal offering access to more than 58 million cultural heritage items, including documents, manuscripts, photographs, maps, artworks, and material culture objects. The content is contributed by thousands of different providers such as national libraries, museums, universities, and private collections. Through *Europeana*, users can search and retrieve records from multiple countries and thematic domains within a unified and interoperable environment. The platform leverages advanced technologies and standards to ensure interoperability and seamless access, while also promoting multilingualism and cultural diversity [5].

Europeana is more than a repository of digitized content. It places particular emphasis on the development of advanced metadata methodologies to improve the organization, discovery, and reuse of digital resources. To manage metadata, it has developed and implemented the Europeana Data Model (EDM), a standard model based on linked data principles that incorporates elements from existing international standards such as Dublin Core and CIDOC-CRM. This model serves not only as a technical backbone but also as an active structuring tool that shapes the organization and meaning of digital records [8].

The EDM enables rich description of records through links to other objects, entities, events, or collections. For example, a historical document may be associated with its creator, place of origin, related exhibitions, or other relevant items. The use of EDM creates a dynamic search and navigation environment, allowing users to discover new connections and historical contexts. It also supports interoperability with other systems and facilitates the reuse of data across different domains. The networked logic of EDM enables the reconstruction of fragmented collections, enhancing the multimodal reading of the past.

In parallel, *Europeana* implements initiatives to improve metadata quality through programs such as the Europeana Publishing Framework and dedicated data enhancement guidelines. These initiatives aim to ensure metadata completeness, consistency, and multilingual accessibility, facilitating access for diverse user groups. *Europeana* works with its partners to promote shared standards and strengthen interoperability, supporting the exchange and reuse of data. Metadata quality is not treated merely as a technical concern but is directly connected to goals of institutional inclusion and cultural representation [5].

In practice, the Greek experience demonstrates that

aggregating content for *Europeana* requires overcoming technical and organizational challenges, particularly with regard to repository heterogeneity and metadata inconsistency [9]. Moreover, the architecture of digital networks itself imposes limits on who and what is included or excluded, raising issues of cultural representation. Apparent technical neutrality does not eliminate the need for ongoing critical awareness of potentially exclusionary or implicit practices. Despite progress, inconsistent metadata quality continues to affect access and discovery experiences for historical sources [10].

Thus, *Europeana* emerges as a model project for transnational management of digital cultural heritage, offering opportunities while at the same time raising critical questions regarding access to and use of archival material in the digital age.

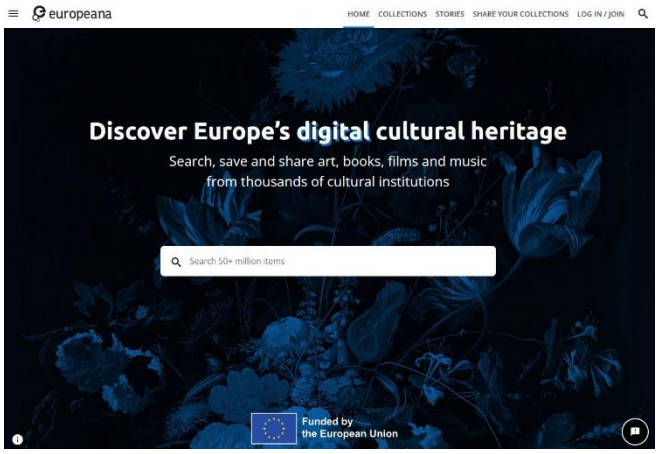

Fig. 1. Homepage of Europeana, the European Union's digital cultural heritage platform. The portal provides access to over 50 million items contributed by cultural institutions across Europe. Source: https://www.europeana.eu/ [accessed 28 April 2025]

Fig. 2. Thematic landing page for World War I on Europeana. Users can explore digitized content related to the First World War, including official histories, propaganda, personal narratives, and photography.
Source: https://www.europeana.eu/en/themes/world-war-i [accessed 2 May 2025]

IV. OPPORTUNITIES AND SHIFTS IN HISTORICAL RESEARCH THROUGH EUROPEANA

The digitization of historical archives, particularly through platforms such as *Europeana*, offers a wide range of opportunities for historical research. Most notably, it significantly expands access to materials that were previously geographically, administratively, or financially difficult to obtain. Through *Europeana*, records from different countries, historical periods, and thematic areas become accessible to any interested party, regardless of location or institutional affiliation. This expansion of access enhances the democratization of historical knowledge and helps dismantle traditional barriers to academic research. Furthermore, it enables reuse, collaborative curation, and the creation of new digital narratives, strengthening the interaction between researchers and archival material. *Europeana* also promotes the development of digital skills and the enhancement of digital literacy, supporting active citizen engagement with cultural heritage [5].

Digitization facilitates new methodological approaches to historical analysis. Researchers can use full-text search tools and apply data mining or big data analysis methods to large corpora of documents, enabling insights at scale. The interconnected nature of *Europeana*'s data, through the Europeana Data Model (EDM), enables the creation of new research pathways, as records can be linked based on themes, creators, events, and locations. This functionality activates dynamic models of historical interpretation, based on associations that may not be visible in analog collections. *Europeana* also supports the development of digital tools and services that allow researchers to process, analyze, and interpret digital data in novel and innovative ways [8].

Another significant advantage is the platform's multilingual dimension. *Europeana* supports multiple languages, facilitating the discovery and understanding of records from diverse cultural and national contexts. This capability fosters comparative studies and promotes a more pluralistic perspective on European and global history.

Another key benefit lies in the preservation of original documents. The broad availability of digitized materials allows researchers to study archival records without exposing physical originals to wear and damage from handling. In this way, digitization contributes not only to dissemination but also to the long-term preservation of historical heritage.

At the same time, the user's navigation experience within digital archival collections plays a decisive role in the ability to utilize the material for historical analysis. The usability of a digital environment affects efficiency, memory, error rates, and overall user satisfaction—factors that are critical for the deep engagement with historical sources [11]. Designing interfaces tailored to the needs of researchers—particularly non-technical users such as historians—is essential for making digitized materials truly usable. A lack of a user-friendly and transparent search environment can discourage further inquiry, even when initial access is available.

Users of digital archival collections highly value the immediate availability and ease of access that such platforms provide. However, there is also a clear demand for

more consistent documentation and clearer presentation of historical context. This highlights once again the importance of rich, consistent metadata for the effective and meaningful use of digitized collections. The absence of contextual information renders records vulnerable to misinterpretation, particularly when they are not accompanied by provenance data, original ordering, or relationships to other archival units [12].

Overall, *Europeana* constitutes a powerful tool for revitalizing historical research, opening new horizons in terms of sources, methods, and theoretical approaches to historical narrative.

V. CHALLENGES AND CONSTRAINTS IN HISTORICAL RESEARCH THROUGH EUROPEANA

Despite the significant advantages offered by the digitization of historical archives, the use of platforms such as *Europeana* is accompanied by important challenges and limitations that affect both access and the interpretation of historical records.

One of the main challenges is the heterogeneity and inconsistency of metadata. Since the archives and cultural institutions contributing to *Europeana* come from diverse national contexts, local practices, and technical systems, the quality and completeness of metadata vary significantly [9]. Inconsistent record description can hinder searchability, cause contextual information to be lost, and impede the understanding of a document's significance. Moreover, the wide variation in metadata fields can make it difficult for users to understand the digital representations and their original archival contexts [12].

Another critical issue concerns intellectual property rights and access restrictions. Although *Europeana* promotes the widest possible availability of material through open access, a substantial portion of the records remains subject to usage restrictions due to copyright or contractual agreements with content providers. *Europeana* actively works to strike a balance between rights protection and facilitating access, exploring alternative licensing models and promoting awareness around copyright issues in the cultural heritage domain [5]. The protection of cultural heritage in the digital realm presents complex legal, technical, and ethical challenges, while the absence of standardized metadata protocols and interoperability contributes to fragmented policy implementation [13]. At the same time, the commodification or instrumental use of digital memory raises ethical and epistemological dilemmas.

Multilingualism, while enhancing accessibility, also complicates content standardization and interpretation, as variations in language or cultural context can introduce ambiguity for researchers. The need for clarity, standardization, and transparency becomes increasingly urgent.

The issue of authenticity has gained particular relevance in the digital age. The transition to digital form can sever important elements of a record's authenticity—such as materiality, texture, or physical wear—that are critical for historical interpretation [14]. If digital representations do not adequately preserve evidence of the original, they may fall short of satisfying scholarly demands [15]. Additionally, fragmentation and the absence of contextual metadata lead many historians to perceive digital collections as *"quietly incomplete"* [16].

The very acts of digitization, description, and presentation constitute forms of cultural curation. Decisions about what gets digitized and how it is described fundamentally shape which narratives are highlighted and which are marginalized [2].

These challenges underline the need for continuous critical engagement with digitized archival access—an approach that seeks not merely technical availability, but also critical and meaningful engagement with historical information.

VI. CRITICAL REFLECTIONS ON DIGITAL ARCHIVAL ACCESS THROUGH EUROPEANA

The analysis of Europeana as a case study highlights the complexity of contemporary archival access in a hybrid digital environment. On one hand, the digitization and integration of European cultural collections offer significant opportunities to broaden historical research, increase the participation of diverse social groups, and expand understandings of cultural heritage. On the other hand, it becomes clear that digitization does not eliminate the challenges related to authenticity, accuracy, and the interpretive complexity of historical documentation.

Metadata quality emerges as a key factor in the success or failure of digital access. The heterogeneity of data constitutes a major barrier to effective access [9], while assessing the quality of documentation continues to pose challenges, even on platforms that employ unified standards [17]. Problems of inconsistency and incompleteness in metadata burden the research process, limiting the interpretive reliability of digital collections. Especially in environments that aim to aggregate material from diverse sources, such as Europeana, the issue of semantic harmonization remains unresolved. It is not enough for documentation to be voluminous—it must also be semantically coherent and meaningfully interconnected [9].

At the same time, the transition to digital forms of documentation gives rise to a new type of historical object—digital and detached from its physical form—requiring the development of new methodological tools for evaluating authenticity and trustworthiness [14]. The hybrid nature of digital archives demands that researchers not only possess technical literacy, but also maintain critical awareness of the choices embedded in the digitization and descriptive processes [2]. The detachment from the physical base of a record can hinder the perception of its material context, especially when analytical descriptions of its original arrangement, provenance, or physical characteristics are absent [14].

This underscores the need for a new archival ethos in the digital domain—one grounded in the critical management of metadata, transparency in digitization processes, and a conscious effort to integrate diverse narratives [2]. The call for participatory curation and intercultural perspectives becomes increasingly urgent. Europeana, despite its limitations, offers a valuable example of how these goals might be pursued—provided there is continuous institutional vigilance and reflective scholarly engagement [5]. Editorial Policy

The submitting author is responsible for obtaining agreement of all coauthors and any consent required from sponsors before submitting a paper. It is the obligation of the authors to cite relevant prior work.

Authors of rejected papers may revise and resubmit them to the journal again.

VII. CONCLUSION

The examination of Europeana as a case study has illuminated the multifaceted impact of digitization on access to and use of historical archives. Digitization and the online availability of records have the potential to radically renew historical research, remove traditional access barriers, and enable the development of new research approaches. Europeana exemplifies the possibilities offered by digital archival platforms, particularly in terms of international collaboration, thematic interconnection, and expanded accessibility.

However, the analysis also revealed fundamental challenges that accompany digital archival access. The heterogeneity and inconsistency of metadata remain significant obstacles, as they directly affect the ability to search, retrieve, and interpret records. Copyright restrictions often limit the reuse and broader dissemination of materials by both researchers and the public, while issues of authenticity and contextualization undermine the critical engagement with digital sources. At the same time, the processes of selection and description of archival materials may perpetuate existing cultural exclusions, thus limiting the representation of less visible social groups.

Despite these challenges, Europeana stands as a functional and ambitious model of supranational archival infrastructure. The success of similar initiatives largely depends on the continuous improvement of metadata quality and consistency, the provision of targeted training to contributing institutions, and the harmonization of metadata practices. Establishing transparent digitization and documentation procedures—along with clear publication of the criteria used for selecting and describing records—is essential for maintaining the reliability and scholarly usability of the materials. Moreover, the regular assessment of access and use, based on both quantitative and qualitative data on user experiences, could help identify practical issues and enhance inclusivity. Finally, promoting polyvocality and integrating diverse narratives—especially those of marginalized communities—are critical for the democratic and equitable articulation of historical memory.

The digital age presents unique opportunities for the preservation, dissemination, and reflective interpretation of historical knowledge. Fully realizing these opportunities, however, requires shared critical awareness, technical competence, and ethical responsibility from all involved institutions, professionals, and users.

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Journal of Integrated Information Management electronic journal

Post-mortem Photography as Memory, Mourning and Material Evidence in Late 19th–Early 20th Century Greek Archives

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Article Info

Article history:
Received 19 June 2025
Accepted 02 July 2025

http://dx.doi.org/10.26265/jiim.v10i1.41853

Abstract:

Purpose — *This paper focuses on post-mortem photographs that had been produced in Greece between the late 19th century and the first decades of the 20th century, either from Greek or foreign photographers. The photographs examined are included in museums and public photographic archives as well as private collections in Greece and they are examined as a memento and as a piece of documentation. The aim of this study is to shed light both on the literal and symbolic implications of post-mortem photography in Greece and thus to document and critically examine the photographs through the historical, social and cultural conditions of the period in which they were created.*

Design/methodology/approach — *This study employs a qualitative methodological framework, aiming to explore and interpret post-mortem photography as a socially constructed phenomenon. Emphasis is given on the critical examination of the visual and symbolic dimensions of the photographic representation of the dead body as well as on the cultural narratives that underpin this photographic practice. The study is grounded in original archival research, direct visual analysis and comparative study of the photographic material and the documentary evidence. It is also complemented by a comprehensive literature review in the fields of art history and cultural studies.*

Findings — *The findings of this study extend beyond the mere documentation of photographic archives, offering an in-depth analysis of societal attitudes toward the deceased and broader perceptions of death during the period under consideration.*

Originality/value — *This study constitutes an original research endeavor derived from the author's independent investigation. Given that post-mortem photography in Greece has not been yet fully studied, the aim of this work is to contribute to the existing body of research on Greek photography, as well as to the scholarly research of Greek photographic archives.*

Index Terms — Post-mortem photography, Greek photographic archives, funeral photography, 19th century photography, visual representation of death, archival research.

I. Introduction

Taking a photograph often stems from a desire to create an archive. There is a strong connection between photography, memory and the archive as the evidentiary power of photography is indisputable. This power is especially evident in memorial post-mortem photography, where images function as records that preserve the memory of the deceased and provide a means of remembrance within personal and collective archives.

In Greece, the visual representation of death is approached with ambivalence, reflecting broader tensions between tradition and modernity. While post-mortem photography is attracting increasing interest among researchers, the field remains largely underexplored, with no systematic studies to date. Despite this gap, a significant corpus of post-mortem photographs survives, spanning from the mid-19th to the mid-20th century. These images, located in photographic and historical archives as well as in private collections, constitute valuable material evidence for examining practices of mourning, memory-making, and visual culture in modern Greek society.

II. The Value of the Photographic Image as a Carrier of Meaning

Interest in the study of images and their historical significance within academic research has been steadily increasing over the past two decades. This growing trend reflects shifting approaches to the production of knowledge, as the relationship between theory and practice, image and truth, is being re-evaluated [1]. Within this context, photography holds a particularly significant position, having attracted scholarly interest due to its crucial relationship between the subject and its representation. Interpreted as an imprint of visible reality, photography emerges as a reliable, authentic, and indisputable document. From this perspective, it is not merely regarded as another form of visual representation, but rather as "a practical realization of objectivity and detachment" [2].

Beyond photography, images in general constitute

immaterial, meaning-bearing objects that possess the ability to convey messages more persuasively than verbal language. As Fahmy, Bock, and Wanta note, "because they often operate through emotional and subconscious processing, images elicit a stronger and more immediate response than text, as they do not rely on the logic inherent in written language, but rather on instinct and emotion to generate meaning" [3]. This emotional activation becomes even more intense in the case of photographic depictions, particularly those capturing traumatic or shocking events. The viewing of such images can provoke an immediate and strong emotional response, rendering photography not only a carrier of information but also a powerful medium of emotional reception [4]. Therefore, photography is not considered a neutral or passive form of recording, but rather a bearer of meaning, capable of profoundly influencing human experience through its emotional power.

III. Post-Mortem Photography: Origins and Evolution

One of the most emotionally charged photographic subject one can capture is the deceased human body. There is no doubt that the mere sight of a dead person evokes emotions such as grief, pain, and discomfort over loss; feelings that contemporary Western societies, with their ideals of beauty and eternal youth, struggle to manage.

Photography in the 19th century included the depiction of various aspects of life, although the vast majority of photographs primarily captured either natural landscapes or people. Since its beginning in 1839, photographic practice has included the photographing of the dead among its applications, as death -being an integral part of life- could not be excluded from this emerging trend of documenting the surrounding reality. According to thetestimony below, one of the earliest attempts in photographic representation may have been the photographing of a deceased person. In October 1839, shortly after the official presentation of the invention of photography, Dr. Alfred Donné, experimenting with the new daguerreotype technique, sent a sample of his images to the French Academy of Sciences. In his letter, he wrote: "I have the honor of sending you some new images made using the daguerreotype method, which I submitted, as initial trials, to the Academy. I have already achieved a great result by capturing the image of a dead man." Unfortunately, no trace of this daguerreotype has been found [5]. This early documentation of photographing a dead person highlights not only the connection of photographic practice with death from its very beginning, but also the cultural context within which it was received. In the early 19th century, people did not regard death as something macabre, as is often the case today, but rather as an inevitable, expected, and perhaps even welcome condition within the natural cycle of life.

The photographing of the deceased began with the aim of capturing the facial features of those departing from life, so that their relatives could have a photograph of them as a keepsake. As a practice, it must be viewed and interpreted under the light of social beliefs surrounding death and mourning, as well as the expectations of the deceased's relatives of the time. In the early years, very few people had managed to obtain a photographic portrait of themselves. The newly invented art form had not yet become widespread, and the only means of representation previously available was a painted portrait.

Consequently, the post-mortem photograph was the one and only depiction of the deceased; it was simultaneously their first and last portrait, which remained within the family as a memento. The essential function of such an object is, after all, to preserve the memory, since the keepsake primarily serves to activate an imaginary representation of the object or an experience associated with it. In this sense, it constitutes a private image, accessible only to the subject to whom it is addressed. Moreover, the photograph also served as a family heirloom, bequeathing the facial features and memory of the deceased to future generations.

In the early photographic period (1840-1880), post-mortem photographs were mostly close-up portraits depicting only the upper torso of the deceased. Also, photographers often tried to create the impression that the subject was still alive and merely sleeping. In the years coming, people's needs as well as the photographic style changed, so other photographic types in post-mortem portraits appeared, such as the funeral photography.

Apart from the photographic techniques employed by practitioners, the content of the images themselves was even more noteworthy. It is quite notable that a significant number of early post-mortem portraits depicted children.

It was not uncommon for parents to be photographed holding their deceased children in their arms.

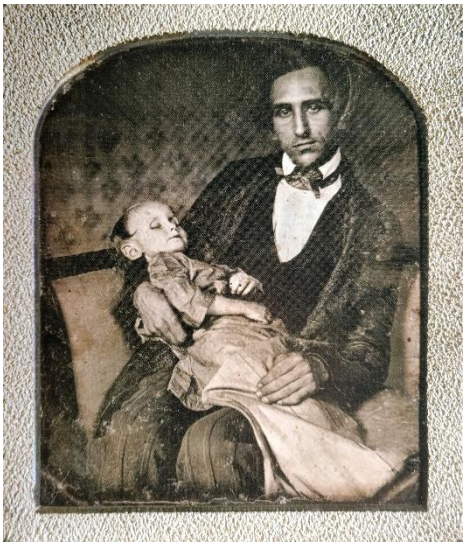

Fig. 1. *Father and deceased son, c.1844, daguerreotype, The Thanatos Archive*.

Typically, the photographer posed the parents in a manner that conveyed the sorrow and grief they felt. At times, however, their pain was expressed through the complete absence of emotion in their utterly expressionless faces. In most cases, the child's eyes were either fully closed, a clear indication that the image was taken post-mortem [6].

The frequent depiction of children in early post-mortem

photographs cannot be understood in isolation from the historical and social conditions of the period. This particular emphasis on child mortality largely reflects the sanitary and demographic realities of the 19th century, especially in the rapidly developing urban areas of Europe. Specifically, in England in 1840, 15–20% of children died before reaching their first birthday. These child mortality rates only began to reverse shortly before World War I, as a result of improvements in living conditions within cities [7]. An important factor for capturing deceased children is the strong likelihood that many of them had not been photographed during their lifetime; so their parents would not have any likeness of them.

Information The high mortality rate of the general population, combined with the rapid and accessible solution offered by photographic portraiture -as opposed to painted portraits- contributed significantly to the spread of post-mortem photography, a practice that persisted into the early decades of the 20th century. This expansion is reflected not only in the growing demand for post-mortem portraits but also in the systematic commercial promotion of the practice. The French photographer Achille Quinet, coming to Greece in 1851, advertised his work, including, amongst others, the photography of the dead: *«Εἰκόνες φωτογραφικαί, ἀναλλοίωται μετὰ ἢ ἄνευ χρωμάτων ἀπὸ δύο δίστιλα μέχρι τῶν ὀκτὼ ὑπὸ τοῦ κ. Κινέ Παρισινοῦ… Ἔτι δὲ κατασκευάζει καὶ εἰκόνας τεθνεώτων».* "Photographic images, altered with or without colour from two trays to eight by Mr. Quinet from Paris. He also makes images of the deceased" [8].

IV. Familiarity with Death in the 19th Century

The spread of post-mortem photography during 19th century was not restricted to a single geographic region but took on an international dimension, including the United States of America, Canada, Europe, European colonies and North Africa as early as the 1840s [9]. In particular, the widespread acceptance of post-mortem photography in Victorian England was not merely a consequence of mourning etiquette, but was embedded in a broader cultural context where death constituted an integral part of daily experience. Thus, people honored their feelings for the deceased through jewelry, clothing and photography. Furthermore, "in Great Britain, post-mortem photography developed rapidly, both as part of the broader commercial photographic applications that were spreading like wildfire and as a component of the general commercial boom in the country" [9]. The continuous development of this practice is also evidenced by photographers who advertised it as a service. Additionally, for several decades -from 1850 to 1930- special albums and cases for the preservation and display of post-mortem photographs were made available by photographers [9].

Subsequently, societies during that era deeply incorporated the social dimension of death. Mourning customs and accompanying rituals were widely accepted and served as a means to pay proper respect to the deceased. The most common etiquette practices involved changes in clothing and certain daily habits. In England, the United States, and Canada an entire industry related to death had developed early on, encompassing specific mourning clothes and accessories, pins and jewelry made from the hair of the deceased, specialized objects for embalming bodies, and behaviors associated with mourning [10].

Fig. 2. *Daguerreotype case, Fotography Museum, Antwerp.*

Fig. 3. *Mourners dressed in black, tintype, 1886, The Thanatos Archive.*

V. Post-Mortem Photography as a Memento

During The incorporation of death into the daily life of 19th century societies was not limited to clothing practices or material mementos but extended to the artistic and emotional representation of loss. Within this context, post-mortem photography emerged as one of the most distinctive cultural artifacts of the era, reflecting not only societal attitudes toward mourning but also deeper Romantic sensitivities concerning the memory of the deceased. More specifically, post-mortem photography, as a common practice within mourning rituals, developed during 19th century as a manifestation of Romanticism and its defining features, such as melancholy, emotional excess, and a spiritual detachment from the earthly realm. One of the

primary functions of photographing a deceased person was the therapeutic effect it offered to the bereaved left behind, while simultaneously confirming the death to relatives who were far away. But above all, it offered relatives the possibility to keep the memory of the deceased alive in their minds [11]. It would not be an overstatement to claim that a photograph, more than any other material medium, enhances the act of memory recall. An image always conveys something of the person it depicts and as Roland Barthes notes: "...it may not be reality, but at least it is its perfect analogy" [12].

This new photographic trend was reinforced by the prevailing atmosphere of familiarity with death, which was largely shaped by the religious beliefs of the period. In the 19th century, children were taught that death was a passage to a better world where they would reunite with their loved ones who had passed away [13]. Post-mortem photography became so popular that by the late 19th century, almost every family owned a photographic portrait of a deceased relative. "For some, post-mortem photography is a Victorian whim, the product of a particular mindset about death that no longer exists, while for others, its existence today is an enigmatic relic" [14]. However, neither of the two views is as close to the simple truth that post-mortem photography was both a photographic and a social product, perfectly compatible with the prevailing cultural atmosphere of its time.

In terms of technical developments in photography, from 1880 onwards, the replacement of the wet collodion process by the dry collodion process and silver gelatin print [15], allowed people to be photographed easily and quickly during their lifetime, and gradually photography became accessible in almost every household. During the 1850s and 1860s, several methods for dry collodion photographic capture and printing were proposed by chemists and scientists. In 1862, Sutton published details of a "rapid drying process" based on the tannin method. The "instantaneous" images were taken using the dry collodion method, although the short exposures with dry collodion likely required considerable skill and a lot of luck. In 1864, W.E. Bolton and E.J. Sayce announced a significant development: a process involving the mixing of silver bromide into collodion to form an emulsion. This was the first practical photographic emulsion. From then on, many people owned at least one photographic portrait of themselves while being alive and thus the need for post-mortem photographs gradually decreased.

Also, at the dawn of the 20th century, human life expectancy had been steadily increasing, while social perceptions and beliefs about death and mourning were changing. Death was no longer regarded as a natural consequence of birth and living, as it had been in the past, but rather as an illness or disorder. Sociologist Lindsay Prior points out that death is no longer attributed to natural causes, such as aging, neglect or fortune, but is seen as the result of pathological conditions. The fact that dying has been relocated from home to the hospital reflects the dominant perception of it as a purely biological fact. An indication of this change is that, at the moment of dying, a doctor is usually called rather than a priest; a practice that reveals significant changes in the way society perceives human mortality [16]. A comparable perspective was articulated by the British painter Francis Bacon in 1962:

"Of course, what man does now is to deceive himself for a little while by buying a kind of immortality from the doctors, in his attempt to prolong life. In the same way, art today has become a kind of game through which one forgets — of course, you could say it was always like that, but today it is exclusively so" [17].

With the advent of the 20th century, the tradition of post-mortem photography began to gradually decline as it became less and less popular in modern Western societies, where a funeral portrait started to be seen as unnecessary and macabre.

VI. Post-Mortem Photography as a Piece of Documentation

During The function of post-mortem photography has, inevitably, evolved over time. From its original purpose—the visual documentation of the deceased and the recording of death itself—to its later, distinctly commemorative use, both photographers and the families of the deceased engaged with the medium with a variety of perspectives.

For many decades the primary function of post-mortem photography was commemorative. In its early years, post-mortem photography served to preserve the memory of the deceased's facial features, to capture the individuals who were often being photographed for the first and last time before being buried. James F. Ryder, one of the earliest photographers to engage in post-mortem portraiture and owner of a daguerreotype studio in New York State during the 1850s, recounts the plea of a grieving mother who implored: "Oh! sir, my child Armenia is dead, and I have no likeness of her; won't you come immediately and take her a picture" [18].

Moreover, photography, as a carrier of information, assumed the role of documentation, an undeniable proof of death. As Kostas Ioannidis claims: "Documentation has always been the central aim of photography—the accurate depiction of an event deemed significant enough to be recorded. Ideally, documentation should always depict, ideally even reflect." Since the 1960s, post-structuralist theorists have strongly criticized both the concept of documentation and the very notion of photographic reality. The documentary photograph, even in its most utilitarian forms, was re-examined as a constructed product, going beyond mere representation. John Szarkowski, drawing on American advertising photography of the 1960s and the work of Walker Evans, emphasized the descriptive nature of photography and its strong connection to the visible world, noting that its meaning is confined within the image itself—photography does not interpret, it merely shows [19].

All the elements that give meaning upon a post-mortem photograph are embedded within the image itself; thus, no additional documentation, prior knowledge, or imaginative

effort is required for the viewer to comprehend its content. The positioning of the deceased -whether laid on a bed or placed within a coffin, with hands crossed over the chest and eyes closed- as well as the objects surrounding him, all indicate the finality of death. The decorative elements and symbols commonly accompanying the deceased, such as the Cross [20], flowers and sometimes a religious icon, compose a universal narrative of human mortality. The Cross carries particular symbolic weight, as it is the universal emblem of Christ and Christianity—having appeared in Egyptian tombs long before the birth of Christ—and is associated with the salvation of the soul. It embodies a synthesis of opposites: the positive (vertical) with the negative (horizontal), life with death, and the spiritual (vertical) with the worldly (horizontal). Today, it remains a prominent symbol throughout the Christian world—both Catholic and Orthodox.

Although post-mortem photography was mostly established as a memento within the context of mourning, there have been several cases in which it has been used as evidence in criminal investigations, contributing to the resolution of crimes involving loss of life. It is likely that a number of photographers were engaged in the task of photographing corpses, under the law for anthropometry, began in 1906 [19]. A photograph of this kind was a documentary evidence within the context of police investigation.

VII. The Greek Photographic Archives

The study of Greek post-mortem photography is structured around the practice of photographing the deceased, as shaped by customs, beliefs, and traditions of modern Greece, as well as by the prevailing perceptions of death during that period. The practice was influenced by foreign traditions; as was the case with photography in general during that period. Greece, as a small agrarian country, established its own parameters in post-mortem photography. The initial focus on an individual post-mortem portrait -depicting the deceased without the presence of others- soon expanded to a group portrait, that included the whole family of the deceased. Nevertheless, whatever the circumstances, interest in post-mortem photography in Greece never was as popular as it was in modern Western societies, such as England and the United States. And so is the case nowadays concerning the scholar study of post-mortem photography. In contrast to the United States, where several databases exist, such as: The Thanatos Archive (https://thanatosarchive.com/), the Burns Archive (https://www.burnsarchive.com/) or the Post-mortem photography archive of the Williams Clement Library (https://clements.umich.edu/exhibit/death-in-early-america/post-mortem-overview/) to name a few, in Greece we lack a systematic database. The number of relevant photographs held in museums and research institutions within the country is very small. Also, taboos around death in contemporary Greek society makes it even harder for the scholars to locate unknown post-mortem photographs; the majority of which remain in the possession of the deceased's family members (and it's hard to be located) or individual collectors who are passionate about this particular photographic genre.

It is a fact that post-mortem photographs are often destroyed by the descendants of the deceased, instead of being donated, for example, to a public archive [21]. In Greece, attitudes toward death and its visual representation remain ambivalent. Nevertheless, a noteworthy corpus of post-mortem photographs survives today, dating from the mid-19th to the mid-20th century. These are either already known published photos that belongs to museums and research institutions or unpublished photographs from private collections. Most notable archives and collections are the followings: Hellenic Literary and Historical Archive-Cultural Foundation of the National Bank of Greece (ELIA – MIET), National Historical Museum, Christos Kalemkeris Photography Museum of the Municipality of Kalamaria, Leventis Municipal Museum of Nicosia, the archive of Panagiotis Fatseas, a photographer from Kythera, the archive of Panos Iliopoulos, a photographer from Messinia, the archive of Leonidas Papazoglou, a photographer from Kastoria, private collections of Spyros Gaoutsis in Corfu, Nelly Pantazi in Corfu, Dimitrios Kasapidis in Xanthi and Platon Rivellis in Athens.

Concerning the Greek photographers that engaged in post-mortem photography, the most renowned were: Philippos Margaritis (1810–1892), Anastasios Gaziadis (1853–1931), Nikolaos Birkos (1854–1924), Manolis Megaloeconomos, and brothers Xenophon and Solon Vathis. Most of them owned private photographic studios either in Athens or in the provinces [22]. Although there isn't any records, photographing the deceased appears to have been a significant source of income for photographers of the period, many of whom—especially those in rural areas—were itinerant. According to Kostis Liontis, the photographer Giannis Karamanos, who worked in the Argolida region in the early 20th century, earned a good part of his income from photographing the deceased [23].

VIII. Main Categories in Greek Post-Mortem Photography

The categorization of post-mortem photographs in the Greek context follows trends introduced from abroad. The classification is based on whether the deceased is depicted alone or surrounded by other individuals. There are three categories of post-mortem photographs. The first two photographic types suggest that the deceased individual is not, in fact, dead. The first of them, known as the "last sleep", depicts the deceased as though peacefully sleeping, and is related to the religious belief of an afterlife.

The second type, is under the paradox title "alive, yet dead" and portrays the deceased in such a way that they appear to be alive. The third category which called "funeral photograph," is literally a group portrait of the deceased surrounded by family members.

Fig. 4. *Giorgos Moraitis, Post-mortem portrait of a boy, Athens, c.1870, private collection of Alkis Xanthakis*

Fig. 5. *Panagiotis Fatseas, Funeral of an old man (Karydi) in the island of Kythira, General State Archives, Greece, c.1930.*

As Jay Ruby notes in his comprehensive study *Secure the Shadow: Death and Photography in America*:

"There are some stylistic consistencies that appear to straightforwardly reflect cultural attitudes toward the dead and the rituals surrounding them. From 1840 until 1880, three styles of post-mortem photography emerged. Two types were designed to deny death, that is, to imply that the deceased was not dead, while a third variant portrays the deceased with mourners. These conventions should not be regarded as strictly chronological in that once established some continue to be employed to the present time. Changes in styles of representation that do occur at the turn of the century can be attributed to technical and social changes in funerary and burial customs" [18].

In the early years of photography, the primary reason for taking a portrait of a deceased person was to offer relatives a souvenir of their facial features; since it was very likely that no other photograph had been taken of the person during their lifetime.

The first type called "last sleep" -in which the deceased is depicted in a state resembling sleep- not only establishes a symbolic association between sleep and death, reminds us of the twin sons of Nyx, Hypnos and Thanatos, from classical Greek mythology [24], but promises an eternal life awaiting the individual beyond physical death. Thanatos (Death) and Hypnos (Sleep), twin deities in Greek mythology, symbolizing the close relationship between sleep and death. The association between death and sleep finds its roots in ancient Greek mythology, specifically in the figures of Hypnos and Thanatos. These twin brothers, sons of Nyx (Night) and Erebus (Darkness), were anthropomorphic deities who personified sleep and death, respectively. They were linked to a dark, unseen realm untouched by the light of the Sun.

In the second category, known as the "alive, yet dead" type, commonly located in the Western societies, an even more paradox depiction of the deceased is represented. Two key factors contributed to the development of this photographic type during the early photographic period. Firstly, there was a strong desire among individuals to obtain a commemorative image of their loved one in a lifelike state, particularly since very few people had portraits taken while still alive. Secondly, the lack of a distinct photographic identity during this period led many photographers to imitate the conventions of painting.

The third type, which appears frequently in Greek photography, is the one depicting the deceased in the coffin shortly before the funeral, thus is called "funeral photography". In this group portrait -featuring the deceased surrounded by relatives and many times members of the broader community- in contrast to the two previous types, there is no attempt to conceal the reality of death. On the contrary, death functioned as the occasion for a group portrait of the community, thereby affirming the profound sense of solidarity that prevailed within small communities during that period.

Fig. 6. *Leonidas Papazoglou, A dead student in his coffin surrounded by his classmates, Kastoria, Greece, c.1910-1920.*

All three photographic types have been located in every country where this practice emerged. Particularly, during the early photographic period (1840–1880), in the United States and Northern European countries photographers clearly portrayed the deceased as if they were alive. The main characteristics of this "alive, yet dead" type were the open eyes of the deceased, or the seated position in a chair or a couch. A very characteristic photograph, that comes from The Thanatos Archive, is the one that portrays a young boy laying in a couch with his hands crossed on his lap and his eyes wide open, yet void.

Fig. 7. *Post-mortem portrait of a boy with open eyes, c.1855, daguerreotype, The Thanatos Archive.*

Fig. 8. *Xenophon Vathis, Eleni Voulgari , daughter of Lazaros Kountouriotis, c. 1875, Athens, National and Historical Museum.*

In Greece, the "alive, yet dead" type was slightly different, the photographer would take the picture of the body and then turn the photograph 90 degrees so that it appeared to be upright and thus alive. Additionally, through appropriate processing, the face was often isolated to emphasize it more strongly. The post-mortem photograph of Eleni Voulgari, daughter of Lazaros Kountouriotis -currently archived at the National Historical Museum- is such a case. The photographer, Xenophon Vathis, who captured the image of the deceased, also wrote the caption in a vertical direction, so that the photo could be placed in that direction.

IX. Research in the Photographic Archives in Corfu

Throughout my research on post-mortem photography, I came into contact with individuals from various regions of Greece, such as Attica, Macedonia, Peloponnese and the Ionian islands. It is worth saying that in Corfu, people appeared to be particularly well-acquainted with the term post-mortem photography; the mere mention of the phrase was readily understood, requiring no further clarification. This phenomenon was unique throughout my whole fieldwork. Although the research conducted at the Corfu Reading Society and the General State Archives in Corfu did not yield immediate results, my interaction with the archivists led me to the location of post-mortem photographs coming from private collectors on the island.

One of the most striking post-mortem portraits I noticed during my whole research is an individual portrait of a young child, which comes from the private collection of Spyros P. Gaoutsis in Corfu.

Fig. 9. *Bartolomeo Borri, Post-mortem portrait of a child, Corfu, undated, private collection of Spyros P. Gaoutsis.*

Fig. 10. *Bartolomeo Borri, Post-mortem portrait of a child, Corfu, undated, private collection of Spyros P. Gaoutsis.*

The photograph belongs to the category "alive, yet dead" and depicts a young boy dressed in white garments, lying on a bed with hands crossed over the torso and flowers placed upon its body. The boy is photographed in a close-up that primarily captures the upper part of his body. The photograph is oriented vertically so that the body appears upright, perhaps in an effort to look as if it is a living child. The slightly open eyes and lips of the child support this idea. The image is a black-and-white silver mounted in a cabinet card [25]. The cabinet card was one of the most popular photographic formats of the 20th century, consisting of a photograph mounted on stiff cardboard, typically measuring 10.8 x 16.5 cm. Its most common subjects were individual or family portraits, and its name derives from the word cabinet

(referring to a parlor cabinet), as these photographs were often displayed atop such furniture. Cabinet cards were larger than cartes de visite (which measured 6.4 x 9.6 cm), as the depicted subjects needed to be clearly visible from any point within a room. This format eventually replaced the carte de visite (cdv), which was first introduced by André Adolphe Eugène Disdéri in Paris on 27 November 1854. On the back side, the photographer's logo is printed. The photographer is Bartolomeo Borri (1842–1924), of Italian origin, who owned a photography studio in Corfu from the 1860s onward. The studio, named Fotografico di B. Borri and was located at S. Spiridione Street No. 1122, as indicated on the back side of the photograph [31]. In 1875, Bartolomeo Borri participated in the third Olympic Exhibition, where he was awarded a bronze medal. In 1878, he exhibited his photographs at the Exposition Universelle in Paris. In 1890, his son Giuseppe Borri (1873–1931) joined the family studio, prompting a change in the business name to Borri & Figlio. In 1907, they received the "Grand Prize" at the International Exhibition in Bordeaux, and the enterprise remained active until 1943. On the reverse side of the cabinet card, the studio's name and address are printed within an ornate decorative frame.

There is no specific information regarding the exact date of the photograph; however, based on Borri's printed logo, it can be approximately dated after 1875. The printed medal on the reverse side of the card depicts King George I and was designed in 1875 for the Zappas Olympic Games. Its appearance as a decorative element in the logo of the Fotografico di B. Borri studio is likely linked to Borri's participation in the Zappeion Olympic Exhibition, where he may have received an award. The medal bears the following inscription on the one side: "ΑΓΩΝΟΘΕΤΗΣ ΕΥΑΓΓΕΛΟΣ ΖΑΠΠΑΣ, ΟΛΥΜΠΙΑ ΑΘΗΝΗΣΙ και ΤΑΞΕΩΣ Α" (First-Class Award, Zappas Olympic Games, 1875) adorned with a laurel wreath and features the profile of King George I on the other side (https://getty.libguides.com/photography-greece-mediterranean/photographers)

Fig. 11. *Medal depicting King George I.*

The available evidence suggests that the child died sometime between 1875 and 1890, the year Bartolomeo Borri changed the name of his business to *Borri & Figlio* [8] and likely replaced the previous studio cabinet cards bearing the former name, with the new ones. Based on the child's outfit, it is assumed that they belonged to an upper-class family of Corfu [26]. No other post-mortem photograph by Borri has been located, making it difficult to identify his style in this photographic genre.

Such post-mortem portraits featuring open or half open eyes -commonly appeared during the early photographic period in England and the United States- have been identified only rarely in Greece. The open eyes of the deceased, apart from evoking unsettling emotions due to their vacant gaze, contradict Greek funerary traditions. Closing the eyes of the dead, a ritual known since antiquity, was among the first actions to be taken immediately after death and prior to burial, in order to ensure the release of the soul. Specifically, in ancient Greece, since the Homeric era, at the moment of a person's death, one of the first things to be done was to close eyes and mouth of the deceased. While this ritual may have served an aesthetic function, during the historical period it acquired eschatological meaning. As noted in an inscription discovered in Smyrna, likely dating to the 3rd century BC, it was believed that the closing of the eyes ensured the soul's release from the body. During the years of British rule (1814–1864), Corfu began to transform from a fortified town into an urban center, gradually acquiring the characteristics of a small capital city [27].

Portraits of deceased children represent a special category within post-mortem photography, as premature and unnatural deaths tend to trigger intense emotional reactions, often leaving behind a sense of absence and paradox. By the end of the 19th century, two out of every ten children died before the age of five. In the United States, for example, infant and child mortality rates in 1900 were significantly high. Furthermore, in the late 19th century, epidemics of Asiatic cholera, yellow fever, typhus, and plague contributed to high mortality rates even in the modernized states of Europe and North America. Moreover, infant deaths from unknown causes were often regarded as a tragic yet inevitable aspect of life [28].

Within the same collection of Spyros P. Gaoutsis, one more post-mortem photograph was located. The image depicts the Metropolitan Bishop of Corfu and Paxoi, Sebastianos Nikokavouras (1852–1920), who was active from 1899 until 1920. His funeral took place at the Metropolitan Cathedral of Corfu in July 1920. The deceased cleric is depicted in a reclining position inside the coffin, dressed in full liturgical vestments and wearing the mitre, while holding both the episcopal staff and the Holy Bible in his hands.

The photographer focused primarily on the individual rather than the funeral event itself. The deceased is positioned diagonally within the photographic composition, guiding the viewer's gaze toward the focal point of the image, which is the face of the deceased. This image is not merely a record of death, but also a means through which the desired public image of the cleric is constructed. The staging of the body reflects socially and symbolically charged practices. Through such practices, the Church seeks to shape a narrative that reinforces the hierarchical authority of the deceased Archbishop.

Fig. 12. *Post-mortem portrait of Metropolitan Archbishop of Corfu and Paxoi Sevastianos Nicokavouras, 1920, Corfu, private collection of Spyros P. Gaoutsis.*

One more post-mortem photograph located during my research in Corfu depicts an elderly man lying on his deathbed, captured in profile, with only the upper part of his body visible. This photograph belongs to the photographic archive of the Jewish community, housed in the General State Archives of Corfu. According to the archivist, Nelli Pantazi, the deceased man was likely Jewish. However, this is highly questionable, as Jewish custom strictly prohibits the public display of the dead—let alone their photographic representation. Post-mortem photographs were also been sought at the Jewish Museum of Greece; however the officials informed us about the strict rules of the Jewish death rituals, and as expected, the museum's collection contains no such material. Consequently, the identity of the deceased man remains unknown.

Fig. 13. *Post-mortem portrait of a man, undated, General State Archives, Corfu.*

X. Conclusion

This article seeks to highlight the significance of Greek post-mortem photography as a testimony to the social, cultural, and religious practices surrounding death. Despite the limited number of photographs, the restricted public access to such material, and the scarcity of relevant literature, these images offer valuable insights into perceptions of death during the modern Greek period. The experience of this research revealed that in nearly every region of rural Greece, scattered post-mortem photographs exist, patiently awaiting the appropriate opportunity to emerge from obscurity.

Post-mortem photography emerged as a complex social and cultural phenomenon of the 19th century, reflecting contemporary attitudes toward death, memory, and representation. From its initial function as a memento until the lately use as a means of cultural expression, the photographic depiction of the deceased reveals the ways in which societies sought to come into terms with the inevitability of human mortality. The gradual decline of the practice during the 20th century aligns with the deathcare from the family home to the professionalized settings of funeral homes, reflecting deeper transformations in worldviews and social values.

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Journal of Integrated Information Management electronic journal

Archives, Reading Promotion, and the City: Investigating Archival and Library Science Students' Attitudes toward the educational role of historical and literary archives in Reading Engagement

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Article Info

Article history:
Received 16 June 2025
Received in revised form 30 June 2025
Accepted 08 July 2025

http://dx.doi.org/10.26265/jiim.v10i1.42137

Abstract:

Purpose *- This study explores the attitudes of students in the Department of Archives, Library and Information Studies (ALIS) towards the educational role of literary and historical archives in Reading Engagement practices. It focuses on literature as a tool for shaping historical memory and the city as a field of reading and experiential involvement.*

Design/methodology/approach *- A qualitative approach was adopted, utilizing focus group discussions and open-ended questionnaires. A total of 42 students participated in four focus groups, with 20 providing valid questionnaire responses. The case study centered on the literary representation of 20th-century Athens.*

Findings *- Participants acknowledged the significant role of libraries and archives in promoting reading culture and fostering historical awareness. They proposed creative practices such as reading groups, collaborations with cultural institutions, and workshops linking literary materials to historical events.*

Originality/value *- This study contributes to understanding the evolving role of Information Science as a mediator of education. It underscores the importance of enhancing literary and archival literacy among future professionals. Furthermore, it highlights the potential of literary and historical collections to foster multiple literacies (historical, cultural, and digital) among users and to support the social role of Information Organizations as interdisciplinary, participatory, and experiential learning environments.*

Index Terms — Archival literacy, Reading promotion, Literary archives, Experiential learning, Cultural heritage, Urban studies, Historical memory, Information behavior, Focus groups

I. INTRODUCTION: THE ROLE OF LIBRARIES AND ARCHIVES IN FOSTERING A READING CULTURE AMONG USERS

Libraries and archives play a pivotal role in literary engagement and serve as key institutions in cultivating a reading culture, particularly among young people [1]. Beyond their traditional mission as custodians of knowledge, they have evolved into dynamic environments of learning and cultural activation [2], offering stimuli that enhance multiliteracy [3] and promote the interconnection between literature, history, and archival literacy [4]. Through exposure to literary works and historical documents, young individuals engage with collective memory, gain insights into identity, and reflect upon their social roles [5].

The encounter between literature and archival material activates experiential processes, rendering narratives multi-layered and interactive. Reading is transformed into an act of identification, participation, and expression, while literary engagement fosters an intertextual approach and a personal relationship with written discourse. A positive attitude toward literature is not confined to the selection of appropriate texts; it also requires active pedagogical practices such as creative writing, digital storytelling, experiential historical inquiry, and interdisciplinary approaches to sources [6]. Consequently, libraries and archives must redefine their role as open, participatory, and creative cultural hubs [7].

In this context, the study explored the attitudes of students from the Department of Archival, Library & Information Studies (ALIS) toward the educational value of literary and historical archives and their contribution to fostering reading motivation. The qualitative research was conducted during the spring semester of 2025 through focus group discussions

[8]-[9] within courses related to Literature, Cultural History, Archival Studies, and the development of academic and professional skills for emerging Information Scientists. At the conclusion of the discussions, those who wished to participate further completed an open-ended questionnaire, reflecting on their experiences, perspectives, and suggestions regarding the pedagogical use of literary and archival documents in educational and cultural settings [10].

II. Literary Collections, Archival Literacy, and Reading Engagement: purpose and research objectives

Reading Engagement (or Reading Facilitation) is a structured pedagogical and cultural intervention aimed at fostering interest in reading, strengthening personal connections to texts, and developing creative, critical, and emotional skills [11]. These strategies go beyond simple comprehension or reproduction of content; they promote active participation, emotional involvement, critical reception, and aesthetic appreciation. As a contemporary educational practice, they merge literary experience with creative expression, personal engagement, and interdisciplinary learning.

The concept of Reading Engagement is grounded in a broader theoretical framework of literary mediation, wherein reading is seen as a collective experience and a means of cultural empowerment [12]. Its theoretical foundation draws from various pedagogical and philological traditions, including: a. M. Bakhtin's dialogic theory [13], which views the text as a site of dialogue and polyphony, b. Louise Rosenblatt's transactional theory [14], which considers reading a co-creative act between reader and text, c. the critical pedagogies of Paulo Freire [15] and bell hooks [16], which advocate for participatory, emancipatory, and politically conscious learning, d. Reader-Response Theory as articulated by Iser [17] and Fish [18], which emphasizes the reader's role in constructing meaning.

The integration of personal experiences enhances emotional engagement, identification, and self-awareness - core elements in the reading development of children and adolescents- and support the formation of positive reading attitudes in young adults. Experiential Reading, through identification or empathy, paired with an interdisciplinary approach that connects literature to history, sociology, art, and local heritage, provides the foundation for a richer, more expansive reading experience. This set of strategies transforms reading from a passive act into an experiential process, cultivating imagination, empathy, and creativity in learners [19].

The term Experiential or Interactive Reading refers to a dynamic mode of engagement that encourages active participation, communication, and collaboration among readers. This method is implemented across various contexts and thematic units, offering a creative and alternative approach to storytelling. Specifically, it enhances listening, concentration, and expressive skills, while also contributing to the development of social and interpretative abilities, thereby strengthening participants' engagement and sense of agency. Experiential Reading lies at the core of reading communities and aligns with the principles of social-emotional learning (SEL), supporting self-awareness, social awareness, and emotional regulation [20]. Through techniques such as dramatic play, creative writing, personal reading journals, and visual representations, participants are encouraged to enjoy reading, interpret texts through their own experiences, and incorporate them into their personal narratives [21].

Viewed in this light, the process contributes to the formation of narrative identity by providing young people with tools to understand and interpret their experiences [22]. Through guided facilitation, reading is transformed from a static to a dialogic process, whereby participants: a. share personal experiences inspired by the text, b. write or perform as characters, c. explore ethical and existential questions raised by the narrative.

Additionally, the concept of "interdisciplinarity" is inherently connected to the goals and methods of reading engagements, reflecting a contemporary educational imperative to link literature with the arts, social sciences, philosophy, sustainable development, and digital technologies [23]. These practices are situated within the framework of Holistic Pedagogy, which integrates cognitive, emotional, and physical dimensions of learning. Through this integration, reading becomes a vehicle for active citizenship and interdisciplinary knowledge [24], while also enhancing metacognitive awareness and a comprehensive understanding of the world [25].

A central role in these processes is played by Archival Literacy, which involves developing skills to locate, interpret, and critically engage with primary sources. By interacting with manuscripts, audiovisual materials, and oral testimonies, participants access authentic traces of the past—not merely as sources of information, but as catalysts for reflection and creative reconstruction of historical experiences [26]. Archival Literacy offers an innovative enrichment to reading engagements by introducing the concept of evidence-based reading. Engagement with primary sources -whether in physical or digital archives, or

drawn from local and family histories- cultivates critical thinking, historical interpretation, and aesthetic literacy [27].

Incorporating authentic archival materials adds historical depth and multiplicity to the reading experience, especially when used through digital storytelling, oral histories, and interactive applications [28]. The use of archival resources also promotes Intergenerational Learning, particularly through family or community heritage narratives and records [29]. Such practices encourage cultural awareness, emotional proximity to the past, and the development of digital literacy [30]. Furthermore, combining literary texts with archival documentation supports the development of critically literate citizens —individuals capable of evaluating the role of memory, historical narrative, and documentation in public discourse. Engagement with archival material also facilitates the processing of traumatic experiences through narrative therapeutic approaches [31].

In this direction, the present study emphasizes the cultural and pedagogical value of literary and historical archives in activities that promote a reading culture. In a time of ongoing transformations in information, learning, and communication, archival and library institutions must redefine their roles as hubs of cultural mediation and active learning environments [32]. This study explores how archival material can be creatively utilized in educational reading engagements within memory spaces such as libraries and archives, activating young people's imagination and cultural participation [33]. It also underscores the evolving role of archivists and librarians as mediators between citizens and cultural heritage.

The aim of this research is to examine the attitudes of students in the Department of ALIS toward the educational role of historical and literary archives in reading engagements, focusing on literature as a medium for shaping historical memory and on the city as a space for experiential and literary exploration. Within this framework, the specific objectives of the study are:

a. To investigate students' perceptions of the cultural and pedagogical role of archives in reading engagements.

b. To highlight literature as a vehicle for historical memory and as a tool for "reading" the city as a social and experiential space.

c. To document attitudes regarding the role of Information Science professionals as mediators who utilize archival collections to foster reading habits and historical awareness.

d. To explore practical applications of creatively using archival material in educational activities for young adults.

e. To enhance understanding of the contribution of literary collections to aesthetic literacy and critical thinking through their association with memory and place.

f. To deepen reflection on the evolving role of Information Science professionals, as perceived by students preparing to enter the field.

III. Research design – limitations - methodology of the case study

A. Research Design: Criteria for target group and sample selection, limitations, questionnaire design, procedures

This study adopts a qualitative research design, utilizing the method of group discussions (focus groups) to gain an in-depth understanding of the attitudes of students in the Department of Archival Studies regarding the role of historical and literary archives in promoting literary education [34]. To facilitate reflective analysis, a case study was developed under the title *"Literature as a Geography of Memory: The City as a Field of Reading Experience"* focusing on the cultural and social representations of Athens in literary works depicting the city during the Interwar period, the Occupation and Civil War, and the post-Metapolitefsi era. Within this framework, participants were encouraged to reflect on literary portrayals of the city, identifying materials and methods that could foster historical awareness and stimulate reading interest among young adults. Sample selection was based on the critical academic background of students from the Department, deemed essential for the study's aims.

Students enrolled in Archival and Library Science programs were identified as the most suitable population for exploring the intersection of archival education and literary engagement, given that the revised curricula of these departments aim to cultivate such competencies —areas previously underemphasized in earlier curricula. Participation criteria were defined as follows: a. active enrollment in the Department of Archival Studies, b. attendance of at least 7 out of 13 lectures in at least one of the following spring semester 2025 courses: "Literature", "History of the Book and Libraries", "Audiovisual Archives", and "Development of Academic and Professional Skills", and c. participation in a focus group discussion prior to completing the questionnaire. Consequently, failure to meet any of these criteria resulted in exclusion from the sample. Notably, students were allowed to participate in more than one discussion group but could complete the questionnaire only once [35].

The selection of specific courses was guided by their emphasis on the educational role of literary and historical

archives and their contribution to redefining the core skills and knowledge required of Information Science professionals. These courses highlight the necessity for future librarians and archivists to respond effectively to the evolving social and educational missions of information institutions [36].

Focus group discussions were conducted during the third teaching hour of the penultimate lecture in each course. Four groups of 10-15 participants were formed, targeting a total of 40-45 students. Following the discussions, students were invited to voluntarily complete an anonymous, open-ended questionnaire thematically aligned with the discussion topics (5-6 respondents per group). As a result, four groups were formed (each aligned with one course), comprising a total of 42 participants. All discussions proceeded without disruptions and addressed themes such as literature as a vehicle of historical memory, the city as a space of reading and experience, and the contribution of archives and libraries to shaping cultural and reading practices, drawing upon the case study.

Students who wished to continue were invited to complete the anonymous, handwritten questionnaire consisting of open-ended questions relating to the topics discussed. A total of 24 students submitted responses, but 4 questionnaires were excluded due to incomplete answers or internal inconsistencies. The final sample of valid questionnaires included: "Literature" (5), "History of the Book and Libraries" (5), "Audiovisual Archives" (5), and "Development of Academic and Professional Skills" (5) — yielding a total of 20 valid responses. The size of the focus groups was considered appropriate for encouraging meaningful dialogue while avoiding discussion fragmentation. Furthermore, the number of completed questionnaires (20) was deemed sufficient to capture a diversity of viewpoints, enable comparative analysis among students from varying academic trajectories, and provide a representative insight into the Department's student community. It was also ensured that no participant completed the questionnaire more than once [37].

The questionnaire explored participants' perspectives on the educational potential of archives and literature, the creative use of archival material by young adults in the context of the case study, techniques to stimulate reading motivation through an activity centered on Athens as a literary landscape, and perceived challenges in educational archival use, along with possible solutions [38].

Specifically, the instrument comprised nine reflective questions directly derived from the issues raised in the group discussions. These questions examined participants' views on selecting texts and archival resources for the exemplary activity proposed by the research team. Participants were asked to assume the role of a coordinator and outline how they would design an educational initiative within a library or archive to foster literary and Information Literacy. The questionnaire was structured into three thematic sections to ensure conceptual coherence and ease of completion. All questions were formulated as open-ended to allow respondents to articulate their views without the limitations of predefined responses. This choice aligns with the exploratory nature of the study, which aims to reveal participants' experiences, perceptions, and personal interpretations — dimensions unlikely to be captured through closed or rating-scale questions [39].

The first section, "Exploring attitudes toward the educational use of archives" aimed to qualitatively investigate participants' opinions regarding the integration of literary and archival materials by educational and memory institutions. This section sought to elicit: a. participants' assessments of archives and libraries as mechanisms for reading promotion, b. their views on the educational and pedagogical roles of librarians and archivists; and c. the criteria for selecting archival content suitable for such initiatives.

The second section, "Exploring methodological attitudes in reading activities and the role of archives: Case Study Analysis", aimed to delve deeper into participants' preferences concerning methodological and pedagogical strategies for incorporating literary and archival materials into reading-centered educational activities. The section adopted an experiential and applied approach to stimulate critical reflection on methodological issues within realistic pedagogical frameworks. Participants were asked to choose from literary texts and archival materials portraying Athens during three key periods: the Interwar years, the Occupation and Civil War, and the post-Metapolitefsi era. Their selections and accompanying commentary aimed to reflect both the literary landscape and the socio-cultural dynamics of each era [40].

The third section, "Exploring attitudes toward specific challenges and creative archival approaches", focused on identifying participants' perceptions of the practical challenges and innovative strategies involved in integrating archival materials into educational reading programs [41].

All data collected were anonymized and limited to participants' written responses. Anonymity and confidentiality were safeguarded throughout the research process and in the dissemination of findings. Participation was entirely voluntary and proceeded only after students

were thoroughly briefed. The study adhered to academic ethical standards, principles of personal data protection, and informed consent. Participants received a detailed explanatory note outlining the research objectives, the nature of the questions, their right to withdraw at any point, and the guarantee of full anonymity. Submission of the completed questionnaire constituted informed consent [42].

B. Limitations

The small sample size of participants and the study's association with specific courses may limit the applicability of the findings to broader populations. Because the sample was drawn exclusively from students drawn solely from students in the Department of Archival, Library and Information Studies (ALIS), their perspectives might not fully represent the views of students in other academic disciplines, even within the broader information sciences. Future research could expand to include students from different departments, universities, or regions to capture a more diverse range of attitudes toward the educational use of literary and historical archives. Additionally, exploring a wider range of archival types, not limited to literary and historical collections could provide a more comprehensive understanding of archival engagement in educational contexts.

Another limitation relates to the voluntary nature of participation and the reliance on open-ended questions in the data collection process. Participants who chose to take part may have been those with pre-existing interests or stronger opinions about the topic, introducing the possibility of self-selection bias*:* bias introduced by participants' pre-existing interest in the topic*.* Furthermore, while open-ended responses offer rich qualitative data, they can also lead to variability inconsistency in response length and thematic richness*,* potentially leading to blind spots or thematic omissions in certain areas of analysis. These factors should be considered when interpreting the study's findings and planning subsequent research.

C. Justification of the Case Study: the city of Athens as a literary "topos" in the 20th century through archival material

Cultural Geography and Literary Theory, with a particular emphasis on Social Semiotics, converge in recognizing the unique aesthetic and ideological role of literature in shaping spatial perceptions [43]. Within this framework, the distinction between physical space and human intervention becomes blurred*,* as every literary or artistic depiction of urban or natural landscapes inscribes space as a field of human intervention. Accordingly, space is transformed into a "topos" through human perception and operates as a bearer of both individual and collective identity [44].

Under these conditions, "topography" assumes the character of a cultural "topology," whereby space-whether urban or natural landscape-becomes a carrier of cultural values and ideologies. Literature and art propose place as a symbolic construct through which social cohesion is articulated or contested; it thus functions as a mode of cultural self-narration [45]. Through literary mediation, each generation of creators reinterprets the human-space relationship, generating aesthetic representations that reflect either the image of the space itself or that of a dominant social group [46].

No representation of place is ever neutral. The literary depiction of culturally charged spaces contributes to the construction of national identity, thereby assigning literature a crucial sociocultural function. As Bakhtin [47] highlights, language possesses creative and dialogic power, positioning literary texts as sites of cultural negotiation and ongoing redefinition of subjectivity within the social present. Consequently, each cultural inscription of landscape offers a renewed interpretation of its communal significance. In literary and artistic contexts, "landscape" refers to morphological entities endowed with aesthetic, symbolic, or cultural value [48].

From this perspective, the city emerges as a stratified cultural text reflecting processes of urbanization, social transformation, historical memory, and collective identity. Literature often mediates spatial experience through narratives of neighborhoods, public spaces, and demographic shifts, while archival records offer material evidence of these dynamics. The interplay between literature and archive enables a reconstruction of urban identity as a complex constellation of voices, spaces, and histories. Integrating archival material into educational contexts bridges theory and practice, cultivating research, documentation, and narrative skills while reinforcing connections to local history. Libraries, museums, and archives thus operate as dynamic educational environments [49].

Each of the three thematic periods is treated as a distinct unit, enabling correlations between literary production, historical context, and archival material. Interwar Athens is characterized by rapid urbanization and cultural shifts. Writers of the 1920s (K. G. Karyotakis, K. Ouranis) express existential anxiety shaped by the Asia Minor Catastrophe and displacement [50]-[51], while the 1930s generation (G. Seferis, G. Theotokas, M. Karagatsis) seeks new aesthetic and social paradigms, envisioning the city as a site of continuity and renewal [52].

During the Occupation and Civil War, Athens is depicted as a space of deprivation, resistance, and loss. Postwar authors, notably Sp. Plaskovitis, articulate a "novel of ethos," – a novel concerned with ethical reflection and moral testimony – assuming the literary task of preserving traumatic experiences as ethically and politically meaningful narratives [53].

From the Metapolitefsi onward, literature reflects urban transformations – reconstruction, identity crises, and environmental concerns. The second postwar generation (V. Vassilikos, K. Dimoula, M. Koumandareas) critically addresses the altered urban condition, while the 1970s cohort (A. Chionis, L. Poulios, R. Galanaki) assigns political and existential significance to urban landscapes [54]-[55]. Contemporary authors (Ch. Chomenidis, A. Korto, D. Kosmopoulos) further explore urban life through themes of multiculturalism, alienation, and crisis.

This tripartite periodization is structured around four pillars: socio-historical conditions, cultural frameworks, the nature of archival sources, and their pedagogical potential. The methodological approach promotes integrative learning by highlighting the city as a "living text," where temporal layers interact dynamically. Utilizing diverse sources (textual, oral, visual, statistical) enhances educational outcomes by: a) connecting theory with practice through engagement with authentic materials; b) fostering research and documentation competencies; c) encouraging narrative construction inspired by archival content; and d) cultivating a deeper understanding of local history and cultural identity [56].

IV. Structure and Implementation Framework of the Collective Discussion Based on the Three Thematic Units

This case study centers on a collective discussion exploring Athens through literary texts, structured around three thematic units aligned with distinct historical periods and sociocultural phases of urban life. A brief assessment is provided regarding the chosen texts, associated activities, and archival materials. Each research group made use of participants' prior literary knowledge, tailored to the academic orientation of their respective courses. Qualitative data collection was systematically supported by field journals, wherein team members documented observations and key discussion points during group facilitation. The subsequent section evaluates data from questionnaires completed by a representative participant sample, aiming to identify dominant attitudes and potential pedagogical shifts arising from the activity's implementation [57].

A.1. Thematic unit A: interwar Athens and early urbanization; text, archival sources, and indicative activities

As previously noted, the interwar period represents a formative phase in the development of modern Athens and the Greek nation-state. The integration of Asia Minor refugees, the emergence of new social classes, and the establishment of urban culture are defining features of the era, as reflected in its literary output. The two major poetic generations of the period capture this socio-cultural transition through distinct aesthetic modes: the 1920s generation is characterized by elements of symbolism and neo-romanticism, while the 1930s generation introduces Greek modernism [58].

The selected literary texts, with Athens as their focal point, serve as interpretive gateways to urban experience and collective identity. Representative examples include:
a. "Athens" by K. G. Karyotakis, offering an ironic portrayal of the existential weight of the city,
b. "The Lament of the Refugees" by R. Philyras, foregrounding the trauma of displacement,
c. "Syngrou Avenue II" by G. Seferis, illustrating processes of rapid urbanization,
d. Excerpts from G. Theotokas's *Argo*, *Junkermann* and *The Great Chimera* by M. Karagatsis, and *Starlight* by I. M. Panagiotopoulos.

The integration of literary texts with archival materials—such as photographs, maps, oral histories, newspapers, and public records—enabled a multisensory, hands-on reading method, *positively evaluated by students* lthat fostered historical empathy and cultural awareness. Notably, visual materials depicting refugee settlements in Thiseio (Spelios, 1967) and the film *1922* by N. Koundouros enhanced interdisciplinary engagement between literary and visual arts [59].

This pedagogical strategy was positively evaluated; students regarded the theme of Asia Minor Hellenism as highly pertinent to contemporary issues of identity and migration. Literature students showed stronger familiarity with historical literary movements, while those in the "Audiovisual Archives" and "Academic and Professional Skills Development" modules demonstrated notable technical skills. Participants in the "History of Books and Libraries" course exhibited heightened awareness of the links between social structures and cultural production.

Overall, the activity highlighted the necessity of strengthening training for future information professionals in cultural and literary history as well as archival literacy to support the educational roles of libraries and archives.

Subsequent activities within the first thematic unit exemplify how literary and archival sources can be creatively combined to explore urban history, identity, and social change through contemporary educational practices [60]-[61].

> 1.1 Archival Sources: Refugee letters (or fictional letters grounded in real events); student diaries or literary texts from the era (e.g., school magazines).
>
> Activity: Compose, individually or collaboratively, a letter or diary entry reflecting the emotional and experiential perspective of a refugee arriving in Athens for the first time. The text may be included in a virtual "Exhibition of Personal Narratives" (e.g., a digital wall display).
>
> 1.2 Archival Sources: Photographs depicting daily life in refugee neighborhoods; excerpts from housing legislation (e.g., 1923); press reports and political commentary on the refugee issue.
>
> Activity: Create a podcast or audio collage titled "Voices of Arrival", combining readings from literary texts with historical soundscapes, such as port noises or traditional refugee songs, along with narration.
>
> 1.3 Archival Sources: Interwar-era maps and photographs of Athens; press illustrations and front pages depicting urban life.
>
> Activity: Trace the movement of characters from Theotokas's *Argo* on a historical map. Design a digital itinerary based on Alexis' perspective (e.g., "pepper plants," "sunset hues"), and develop an artistic walking diary titled "The City through a poet's eyes."

These activities encourage students to adopt the roles of researcher, creator, and critical reader, using literature as an entry point to explore historical memory and social awareness. In this context, the archive is no longer merely a repository of information but becomes a medium for reflection and inspired interpretation.

A.2. Thematic Unit B: Athens during the Occupation and Civil War

The period of the Axis Occupation and the subsequent Civil War was marked by acute social inequalities, famine, repression, as well as strong networks of solidarity and resistance. Archival documents from this era (including census records, correspondence, and oral testimonies) carry significant experiential and political weight, transforming the city into a stage of daily struggle and acts of resistance [62].

The reading activities focusing on wartime Athens aimed to illuminate the social, political, and psychological dimensions of this turbulent era. Selected literary texts included:

- "Athens 1943" by Nikos Kavvadias, conveying the claustrophobia and irony of urban life under occupation,
- *"*The Foolish Black Marketeer" (1942) by Kostas Varnalis, a satirical critique of moral decay during the black market boom,
- "The Dog's Howl" by Spyros Plaskovitis (from the collection *The Storm and the Lantern*, 1955), examining existential dread in a city under siege.

Additional readings explored collective traumas, such as: N. Kasdaglis' *The Millstone's Teeth* (1955) and A. Kotzias' *The Siege* (1953), which depict the early signs of the civil conflict that would soon erupt in Athens [63].

The experience was further enriched through selected excerpts from "Resistance" by K. Athanasoulis, "That Morning" by M. Alexiou, "Charis '44" by M. Anagnostakis, *Axion Esti:* "third reading, The Great Exodus" by Odysseas Elytis, "Resurrection" by A. Sikelianos, Volume II of *Invalids and Wayfarers* by G. Theotokas, and *The Descent of the Nine* by Th. Valtinos.

Archival materials enhanced understanding of this complex period and included:
a. wartime photographs of Athens (e.g., by V. Papaioannou, also used in the questionnaires), b. images of soup kitchens and public executions, c. citizens' letters, diaries, and oral accounts from resistance members, as well as censored and underground press articles, d. official documents and registries pertaining to arrests or executions,
e. maps marking sites of conflict or acts of resistance.

These resources enabled participants to connect literary representation with tangible historical evidence, thereby encouraging a multidimensional reading of the city as a polyphonic archive. During the discussions of this thematic unit, students expressed strong interest in texts addressing hunger, suffering, and violence, recognizing both their emotional resonance and historical significance. A majority of participants acknowledged that the informed use of literary collections and archives can contribute meaningfully

to democratic education and the promotion of human rights [64]-[65].

Notably productive was the dialogue surrounding censorship and information access-issues explored across departmental curricula. Additionally, the pedagogical and affective power of photographic archives was emphasized, particularly as a means of fostering creative engagement with literary texts.

Indicative Activities for This Unit:

2.1. Archival Sources: Photographs from the famine of winter 1941-1942; newspaper clippings from the Occupation period; food ration cards and soup kitchen tickets.

Activity: Collaboratively produce a digital comic or visual diary using key phrases from literary texts and selected historical images. The aim is to narrate otherwise invisible stories of ordinary citizens.

2.2. Archival Sources: Censorship bulletins, banned literary works, and excerpts from letters or diaries of the time.

Activity: Participate in a hands-on workshop titled "Censorship and Literature". Analyze censorship documentation, attempt to reconstruct redacted literary passages, and compose original texts exploring freedom of expression and the role of libraries.

2.3. Archival Sources: Oral histories from the Civil War in Athens (e.g., from EAM, ELAS, the December events); urban battle maps; posters and public announcements.

Activity: As part of a Public History workshop in a municipal library, develop an interactive digital chronicle of wartime Athens, incorporating maps, a timeline, and excerpts from oral narratives.

These multimodal activities actively engage young adults with the historical past while deepening their interpretive reading of literary works. Simultaneously, they aim to cultivate a culture of reading and critical thinking, alongside the development of digital and information literacy.

A.3. Thematic Unit C: Athens from the Post-Dictatorship Era to the Early 21st Century

Rooted in postwar Greece and concluding with the fall of the Military Dictatorship (Junta), this period marks the end of a historical cycle characterized by unresolved cultural and social issues stemming from the Occupation and Civil War. The second postwar literary generation, active from the 1960s, documents rapid social transformations in Athens, emphasizing the urban subject and the city's metamorphosis. Literature from this era serves both as a record and interpretation of contemporary urban history, reflecting transitions shaped by industrialization, mass reconstruction, political and social changes, Greece's EU accession, migration, and urban redevelopment [66]-[67].

The literary output of this period—including works such as *The Striker with the number Nine* (1986) by M. Koumandareas, *Omonia 1980* (1988) by G. Ioannou, *I die like a country* (1978) by D. Dimitriadis, and *The City on Its knees* (2002) by M. Fais—offers valuable material for examining residents' psychological makeup, the boundaries between public and private space, and the shaping of collective memory. Kiki Dimoula and M. Koumandareas depict the alienation of the individual in the metropolis; H. Liontakis and D. Nollas, voices of the 1970s generation, introduce the experience of the dictatorship and challenge dominant narratives through reflective or experimental writing. (Vitti, 2003) Contemporary authors such as R. Galanaki (*The Utmost humiliation*, 2015) and C. Chryssopoulos (*The Parthenon bomber*, 2010; *A flashlight in the mouth*, 2012) explore urban life, alterity, and power relations within the cityscape.

The archival material supporting these reading activities includes: a. photographic archives of Athens from the 1970s to the 1990s: building sites, posters, graffiti, daily life in neighborhoods such as Patissia, b. newspaper front pages and advertising leaflets from the period that reflect cultural trends, social changes, or popular perceptions, c. audio recordings and videos from news broadcasts or testimonies regarding crises (e.g., December 2008 riots), d. census records, statistics on urban development, and municipal documents concerning urban interventions and street renamings.

This thematic unit proved familiar to students, enhancing their ability to connect personal experiences with collective urban memories [68]-[69]. Although many were not previously acquainted with the literary works, students recognized their relevance for contemporary readers. They also acknowledged the need to strengthen literary literacy among future Information Science professionals — specifically, their ability to interpret literary texts in dialogue with archival material and to contextualize them within historical, political, and urban narratives.

Below are indicative activity types for the target group:

3.1. Archival material: Contemporary and older black-and-white or color photographs of central Athens neighborhoods from the 1970s to the present.

Excerpts from oral testimonies about everyday urban life (e.g., migrants, workers). Newspaper articles and social policy bulletins (e.g., regarding urban renewal projects).

Activity: Select an excerpt from one of the discussed literary works (e.g., *The City on Its Knees*) and create a short audio narration (1–2 minutes), expressing personal impressions of an area of the city with which you are familiar. The narration may take the form of an interior monologue, testimonial, protest, or lyrical description.

3.2. Archival material: Excerpts from television or radio news from the 1980s and 1990s (e.g., on social issues such as migration). Posters and printed materials from urban movements, cultural initiatives, or social interventions of the period. Statistical tables showing changes in Athens' population composition (e.g., migration, youth unemployment, changes in occupations).

Activity: With your group, choose an excerpt from either *I die like a country* by D. Dimitriadis or *The Utmost humiliation* by R. Galanaki. Create an alternative radio news broadcast or podcast imagining a day in a "fictional Athens," drawing on both the tone of the selected texts and real historical events. The broadcast should blend fiction with archival data.

3.3. Archival material: Excerpts from studies and publications on youth life in Athens from 2000–2015 (e.g., social struggles). Personal blogs that reflect urban experience during times of crisis. Data from statistical surveys on young people's access to housing, culture, and employment.

Activity: Collaboratively write a letter from "the Athens of tomorrow," using as a starting point an excerpt from either *The Parthenon bomber* or *A flashlight in the mouth* by Christos Chryssopoulos. Each letter is stored in a digital folder/archive, accompanied by a photograph or newspaper clipping that "documents" it. You may present your approach to the other groups and exchange perspectives.

These activities highlight the interplay between literature, archival documentation, and personal experience; they foster historical and social sensitivity, encourage creative expression, and cultivate skills in information and digital literacy.

B.1. Qualitative analysis of the data: perceptions and attitudes of participants regarding the educational utilization of literary and historical archives.

This section presents a qualitative analysis of data from open-ended questionnaires completed by 20 students enrolled in four courses within the Department of Archives and Library Science: Literature (Group 1), History of Books and Libraries (Group 2), Audiovisual Archives (Group 3), and Academic Skills (Group 4). The interpretive approach aimed to explore participants' attitudes, perceptions, and proposals about the role of archival and library institutions in promoting reading culture and their educational and social functions. Thematic analysis focused on comparing convergences and divergences across groups [70].

Participants universally acknowledged the role of libraries and archives in fostering reading culture but proposed varied strategies for actively using documentary materials. Groups 1 and 4 highlighted creativity and outward engagement, suggesting initiatives such as "to create reading groups and activities targeting specific audiences" (Group 1: Respondent 3), collaborative initiatives with institutions like the General State Archives (Group 4: Respondent 2), and "various open workshops promoting books" (Group 4: Respondent 3). Groups 2 and 3 emphasized the link between historical memory and reading preferences, focusing on approaches that "highlight their historical value" (Group 2: Respondent 5) and "bring [readers] into contact with the cultural wealth of the past" (Group 3: Respondent 4). These differences mirror each course's thematic focus but converge on recognizing the dynamic relationship among social history, cultural production, and literary experience.

Regarding the role of archivists and librarians, participants consistently identified multifaceted responsibilities, including organizational, managerial, and educational functions. Groups 1 and 3 especially stressed communication and public engagement: "The role... is the promotion and creation of presentations, events, and organization of reading groups" (Group 1: Respondent 1), and "[for] sensitizing readers" (Group 1: Respondent 3). Participants also noted the importance of "curating the selection of material" and fostering "interactivity" (Group 4: Respondents 1 and 4). Groups 2 and 3 highlighted information management as key to equitable access and educational impact, e.g., "to preserve the existing material and to [classify it]... to facilitate access" and "to create a society well-informed about its past" (Group 2: Respondents 1 and 4), alongside "select[ing] appropriate documents, frame[ing] them with a pedagogical rationale, and promot[ing] experiential learning" (Group 3: Respondent 3). Overall, the dual organizational and educational roles of information professionals were recognized, with Group 1 emphasizing literary education as essential for fulfilling the objectives of libraries and archives.

Three thematic axes emerged regarding archival documents suitable for reading promotion among students and youth: a. adaptation to linguistic and cognitive capacities, b. potential for personal/emotional identification, and c. connection to historical-cultural context. All groups stressed linguistic clarity and thematic relevance: "It must be legible […] according to age criteria" (Group 1: Respondent 5), "It must have vocabulary and language appropriate for the target group" (Group 2: Respondent 3). They also emphasized experiential connection and relevance: "To be experientially connected to the reader" (Group 1: Respondent 2), "To allow dialogue and highlight critical issues" (Group 2: Respondent 1), and "to be relevant to a topic that interests [young people]" (Group 4: Respondent 2). Additionally, promoting historical memory and cultural understanding were decisive: "To highlight the historical and cultural value" (Group 1: Respondent 3), "To promote interest in literature, history" (Group 2: Respondent 5), and to "maintain authenticity and […] allow intertextual or intercultural correlations" (Group 3: Respondents 1 and 4).

Differences reflected disciplinary orientations: Groups 2 and 3 adopted academic and critical stances emphasizing accessibility and historical awareness, whereas Group 1 prioritized reading engagement as a pathway to literary education and reading competence. Yet, all groups emphasized participatory activation, pedagogical training, and interactive user-collection relationships: "connection with the [reader's] experiences […] alignment with the present" (Group 3: Respondent 3).

In sum, the shared focus on linguistic adaptation, personal connection, and cultural-historical relevance reveals a common pedagogical foundation that frames archival documents as catalysts for learning, personal engagement, and cultural reflection. Divergences reflect how each course's thematic orientation shapes students' educational expectations.

The second section of the questionnaire examined attitudes toward methodological issues, revealing key challenges for educators and information science scholars in promoting archival and literary literacy. Participants' choices among thematic units -Athens during the Interwar Period, Occupation and Civil War, and Metapolitefsi to the late 20th century- were fairly evenly distributed, with a slight preference for the Metapolitefsi. This theme was valued for its contemporary relevance and diverse sources, as Respondent 4 of Group 1 noted: "the study of this period allows for a better understanding of the organization of social life, literature, and political thought today." The Interwar Period was often chosen for its timeless issues, such as refugee integration, highlighted by Respondent 2 from Group 1: "the difficulties in integrating other refugee populations into Greek society remain perceptible even today." Some participants, like Respondent 3, proposed combining all three periods, showing an awareness of historical continuity.

Groups 2 and 3 favored the Interwar Period, emphasizing its rich literary output as representative of the era's atmosphere ("it effectively represents the atmosphere of the period," Group 2: Respondent 4), with an interest in urbanization's early social and economic impacts. Preferences for the Metapolitefsi were often pragmatic, linked to material accessibility and familiarity. Across groups, there was a shared focus on lived experience and enduring themes such as refugeehood and censorship, with some attention to literary and historiographical criteria referencing authors like Theotokas, Panagiotopoulos, Ritsos, and contemporary writers including Galanaki, Alexakis, and Vagenas.

In question five, regarding an educational activity for young adults on the Interwar Period, participants chose between a poem by Romos Philyras on refugees and a passage from Theotokas's *Argo* describing an ideal Athens. Thirteen out of twenty selected Philyras's poem, valuing its experiential impact and capacity to foster empathy and historical awareness: "people should learn to see through the eyes of others" (Group 1: Respondent 3). Its contemporary resonance on refugee issues was also stressed: "raising awareness of the refugee issue is particularly important for the holistic education of young adults" (Group 4: Respondent 4). This preference reflects a consensus on literature as a memory and social sensitization tool, despite some concerns about the poetic form's difficulty ("poetic expression is demanding," Group 1). Those favoring Theotokas highlighted the optimistic depiction of Athens before urbanization and its suitability for aesthetic education and artistic activities (Group 3: Respondent 4).

Question six focused on the Occupation and Civil War, asking participants to select literary texts and archival materials for educational use. The literary choices were fairly balanced, with Kavvadias's poem preferred for its emotional accessibility and themes of freedom ("moving, linguistically accessible, with sensitivity to freedom," Group 1: Respondent 3). Others chose Plaskovitis' narrative for its vivid imagery and accessibility or Varnalis' satirical work for encouraging interpretive dialogue on exploitation and censorship (Group 4: Respondent 2; Group 2: Respondent 3). Some proposed interdisciplinary co-reading. All texts were valued for engaging with political themes and the archives'

role in defending freedom of expression: "It sensitizes young people to the value of freedom and shows how literature can speak for every society and era" (Group 1: Respondent 3); "it shows young people […] the consequences of prohibition and censorship… [revealing] the role of libraries and archives as institutions defending freedom of expression" (Group 2: Respondent 1).

For archival materials (question 6b), personal letters and diaries were favored for offering authentic, experiential perspectives that cultivate historical empathy: "Diary documents in the first person can attract readers' interest, while personal letters would encourage further reading of literature" (Group 1: Respondent 1). Archival photographs, press articles, and theatrical programs were also selected to provide tangible visualization of history and everyday life, enriching literary reading: "The discovery and use of archival photographs and articles from the resistance press of the time constitute useful supplementary material to enrich literary reading" (Group 1: Respondent 2). However, some responses lacked pedagogical justification, which weakened their educational proposals. Overall, participants showed critical awareness of literary education's multimodality and the need for interdisciplinary approaches linking literary reading with historical understanding, viewing archival material as essential for creating comprehensive, experiential, and dialogical reading experiences [71].

Finally, question seven addressed reading activities for the Metapolitefsi and later periods, inviting choices on using archival materials with the poem *Pragmatognosia* by Ch. Liontakis. Responses favored combining creative expression, digital media, and critical dialogue. For example, Respondent 1 (Group 1) highlighted creative expression's role in fostering positive engagement; Group 3's Respondent 5 emphasized cinema's appeal to youth; and Group 4's Respondent 3 stressed digital resources' capacity to enhance audiovisual archives and reading skills. Theatrical techniques combined with critical dialogue were seen as effective in promoting historical empathy and written culture: "these methods foster historical empathy and encourage younger generations to discover written culture" (Group 2: Respondent 1); "critical dialogue reveals deeper interpretations of the text and literature's power to speak about society" (Group 2: Respondent 4); "creative expression through theatrical techniques makes reading more interactive" (Group 3: Respondent 1).

The systematic creation of digital resources (e.g., digital narratives, presentations, websites) alongside other art forms such as cinema underscores the recognized importance of interactivity and multisensory engagement for attracting new audiences. Overall, responses highlight the necessity of combining experiential, digital, and critical methods to enhance literature reception and foster historical empathy among library and archive users, positioning archival documents as tools for active learning and cultural connection [72].

Regarding challenges in integrating archival material into educational activities (Section C: Question 8), most responses across all groups focused on technical barriers. Issues include file incompatibility or unreadability (Group 3: Respondent 4), with Respondent 1 (Group 1) noting that "some file format from the archives may not open," and in some cases, archival use may be unnecessary as "discussion is a live process." These obstacles can be mitigated through digital adaptation and technical support. Equally important is the linguistic and pedagogical mediation of materials (Group 4: Respondent 4), as Respondent 2 (Group 1) points out that "the lack of appropriate processing and explanation can weaken the effectiveness of the activity," emphasizing the need for "educational exercises that aid understanding" and connect archival content with literary texts. Collaboration with experts (e.g., historians) is also vital to address cognitive challenges related to language, subject matter, and document format (Group 3: Respondent 3).

A significant pedagogical challenge identified is that archival material, if not creatively and interactively integrated, may discourage participants. Respondent 1 (Group 2) states that "the use of archival material increases difficulty and demands critical skills," while Respondent 2 (Group 2) warns that without proper pedagogical care, the process can become "boring." Overcoming these challenges requires institutional and interdisciplinary support alongside creative, experiential design, ensuring archives become tools for engagement and historical empathy rather than obstacles to reading involvement (Group 4: Respondent 1).

Concerning the transformation of archival documents into narrative media within reading promotion (Question 9), participants agree that archives serve as springboards for creative storytelling, adding experiential and interdisciplinary value to educational initiatives. Students do not see documents as static historical traces but as narrative cores to be reconstructed or dramatized, enhancing emotional and semantic connections. For instance, Respondent 1 (Group 1) describes how a letter can initiate a story highlighting "the individual and the conditions that shaped them." This method links literary experience with historical memory and lived experience. Participants highlight diverse techniques such as theatrical exercises, comics, and the use of music and visual arts (Group 4:

Respondent 5). Respondent 3 (Group 3) adds that "a document can become a narrative medium provided it is framed with questions, creative reading, or theatrical utilization." Facilitators' approaches to each document shape its educational impact (Respondents 1, Groups 2 and 4), while Respondent 3 (Group 2) stresses awakening creativity as essential for engagement: "Theatrical storytelling helps young people feel that the archival material concerns their lives." The use of audiovisual material further "gives a more authentic character" to reading promotion activities (Respondent 5, Group 2).

Despite methodological variety, the unifying principle is that documents must connect with participants' present experiences through experiential or multimodal approaches. In sum, these narratives act not merely as educational tools but as catalysts for cultural and emotional activation, enhancing reading engagement and historical awareness.

V. Conclusions

The findings of this study affirm the significant educational value of archives as cultural artifacts that can be actively harnessed to cultivate reading culture and strengthen the historical consciousness of young people. Engagement with primary documentary materials —such as letters, diaries, photographs, and administrative records—enables learners to connect with the past in an experiential manner, thereby enhancing their capacity for critical thinking, empathy, and interpretative skills. Archives can bridge school learning, university education, literary education, and public history, fostering a participatory and experiential educational experience.

However, for the broad pedagogical utilization of archives to be feasible, a substantial redefinition of the roles of archivists and librarians is required, with an emphasis on their training to actively contribute to the educational mission of Information Organizations. Professional development for these specialists should encompass topics related to the educational use of documentation, museum pedagogy approaches, digital transformation, and interdisciplinary collaboration with educators and cultural institutions. The collaboration between archives, schools, and universities is not merely desirable but imperative for the creation of educational learning communities.

Future research could focus on documenting best practices in collaboration between archival organizations and schools, developing methodologies for the educational use of archives in digital environments, and investigating the perceptions of library users and educators regarding the role of archives in the learning process through quantitative research. Simultaneously, strengthening the institutional and social role of libraries and archives as spaces for open, lifelong learning and cultural empowerment is essential to transform them into hubs of participatory education and active citizenship.

VI. References

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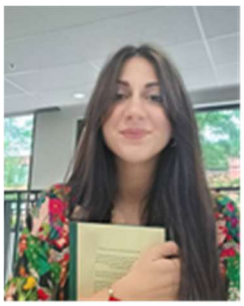

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Journal of Integrated Information Management electronic journal

Innovations and Contradictions in Applying Blockchain Technology in Records Management under General Data Protection Regulation

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Article Info

Article history:
Received 28 April 2025
Received in revised form 12 May 2025
Accepted 02 June 2025

http://dx.doi.org/10.26265/jiim.v10i1.41216

Abstract:

Purpose – *This review aims to highlight the innovations and contradictions of Blockchain Technology applications in Records regarding the General Data Protection Regulation (GDPR) of the European Union (EU).*

Design/methodology/approach – *An extensive literature review was conducted, which revealed of many articles based on research into blockchain, most written from a legal perspective. This report focuses on the extent of analysis of the contradiction that exists between Blockchain information storage and international personal data protection legal requirements, with an emphasis on EU. The variety of proposed solutions to overcome this issue are discussed.*

Findings – *The incompatibility between blockchain technology and data privacy is because of three fundamental inconsistencies: (a) Data cannot be modified once inserted into a block, which conflicts with the right to delete and correct them; (b) Data is publicly available in each participant of the blockchain, a function that conflicts with the principles of confidentiality, accountability, and the designation of a central data processor; and (c) The data is stored indefinitely, in conflict with the GDPR principles related to the purpose, necessity and minimizing of information.*

Originality/value - *This paper presents an original analysis of the implications of adopting Blockchain in Records Management, as well as the implications arising from GDPR.*

Index Terms — Records management, Information Governance, Blockchain Technology, GDPR.

I. Introduction

The advancements in technology have led to an increase in better information management systems. One such system is blockchain, which refers to a digital method used to record information, making it difficult to cheat, modify, or hack [1]. Essentially, blockchain can also be defined as transactions that are duplicated or distributed across a large computer network. A set number of transactions characterizes each block within the chain. Essentially, ledgers are added whenever a transaction occurs within the entire blockchain [1]. Blockchain operates as a Decentralized Ledger Technology, allowing data management by many individuals. Blockchain is crucial in business management, as it simplifies traceability and verification of various commercial transactions, logistics, or product manipulations [2]. In this context, a multistep operation can be easily traced, making tracking and operations more efficient. Blockchain also secures transactions, accelerates data processing, and reduces compliance costs [1]. As an unchangeable digital ledger, blockchain prevents modifications that could lead to malpractices costing businesses. The encryption component also enhances security, preventing unauthorized access.

There are different types of blockchains, including public, hybrid, private, and sidechains. Public blockchains have no restrictions on people's access. Because they are permissionless, anyone with internet access can participate and perform transactions [1]. In contrast, private blockchains are controlled by permission rights, meaning unauthorized personnel cannot access them. Validator participation and open access are not allowed in this case [2]. For hybrid blockchains, both decentralized and centralized features are combined. There is a significant difference between blockchain for record management and blockchain used in general data protection regulation (GDPR) [1]. This review examines the differences between these two and how they relate to blockchain technology.

II. Methodology

This literature review aimed to examine whether blockchain technology can be effectively used in records management without infringing on the General Data Protection Regulation (GDPR) regulations. To investigate this, a thorough review of scholarly and technical sources was performed using reputable academic databases such as Google Scholar, Scopus, and Web of Science, among others. The chosen literature includes peer-reviewed journal articles, white papers, regulatory guidelines, and case

studies published between 2014 and 2025. This multi-source approach provided a well-rounded understanding of both the legal restrictions imposed by GDPR and the technical capabilities of blockchain to ensure transparency, security, and accountability in records management systems.

The primary focus was on technical articles addressing compatibility issues between blockchain transaction recording and the GDPR. Books were also considered to clarify the differences between the two study components. The main challenge encountered was finding material suitable for completing the literature review assignment. Few scholarly articles cover the topic of data management in blockchain. Most reports were irrelevant to this study's aims, making it difficult to find accurate materials. The following inclusion criteria were applied: first, articles were checked for relevance to the study topic; specifically, the report topics should include either blockchain in records management or blockchain and GDPR. Those that passed this criterion were examined for the second criterion, a publication date limit. Only books or papers published between 2012 and 2025 were considered. This chronological period was chosen because of its proximity to the preparation of the EU GDPR regulation, which was adopted on April 14, 2016, and became law on May 25, 2018. Credible data management reports, conference papers, and technology journals were prioritized based on their relevance to the topic.

The methodology also involved participating in seminars, conferences, and workshops on blockchain. In computer science, conference papers and workshops are regarded as equally credible as journal publications because they undergo thorough peer review. It is common for major blockchain advances to be presented at these events before appearing in journals.

III. Blockchain Technology in Records Management

As a distributed ledger, blockchain technology is fundamentally a records management technology [3]. Although the technical details of each platform vary significantly depending on the specific applications of blockchain, the primary purpose of this technology is to maintain valid digital documents that are resistant to violations of their transaction logs and transparent for subsequent review [4]. According to Vigna & Casey (2019) [5], the distinctive features of blockchain technology today make it a reliable platform for various social, economic, and political transactions and interactions. This perspective is echoed by Markey-Towler (2018) [6], who argue that blockchain is a revolutionary technology for records management, as it redistributes power flows and challenges the monopoly control of states and other traditional elites over public records.

A key issue in records management literature is the reliability of systems in ensuring accountability, especially given historical concerns that archives have often been shaped to serve dominant political and social interests rather than democratic transparency [7]. Therefore, guaranteeing archive validity is a critical prerequisite in many fields where management systems identify the essential infrastructures needed to achieve relevant goals [3]. This is vital for all organizations or industries that maintain archival records, such as public registers, cadastral records, and financial transaction repositories [8].

The two main challenges in public and academic debates about records' validity focus on their reliability and authenticity; two interconnected concepts that often overlap with integrity [9]. In the first case, record reliability begins with the process of creation, including conditions related to the creator and associated functions, as recognized by the ISO 15489 records management standard [10] and generally accepted ARMA recordkeeping principles [11]. According to standard 15489:2016, an accurate record is one whose contents can be considered reliable as a complete and precise representation of the transactions, activities, or events it verifies [10]. Similarly, authenticity depends on maintaining the identity and integrity of a record from the moment it is created onward [12]. As acknowledged by the standards above, ensuring integrity involves measures related to access control, user verification, fingerprint identification, and documentation demonstrating normal operation, routine maintenance, and the frequency of updates to recordkeeping information systems [10, 13].

According to Franks (2020) [14], this technology guarantees a reliable recording of data, such as ledgers related to transactions, agreements, events, and contracts, in an independent and verifiable manner. The digital signature in the blockchain is replaced by a series of letters and numbers (hash). Once a data set is logged in the ledger, altering or moving it becomes almost impossible. Each transaction (hash) must match the corresponding history log, making the blockchain a highly transparent platform [15].

The requirements for reliability and authenticity in blockchain systems are fulfilled by the following three main mechanisms:

(1) Incentive mechanism: Blockchain technology uses economic incentives to encourage honest behavior among participants, often through rewards like cryptocurrency tokens. These incentives aim to align individual actions with the collective goal of maintaining a trustworthy and secure system. Because participants understand that following the rules is financially beneficial, they tend to act independently while still adhering to the expected protocols. However, this mechanism faces criticism. Financial rewards can create ethical dilemmas, especially if individuals or coordinated groups exploit the system for personal gain. For example, so-called “51% attacks” — where an entity or coalition controls most of a network’s computational power — have happened in the past, notably against Bitcoin Gold (2018) and Ethereum Classic (2019). These attacks show that, while a single person likely can't compromise a blockchain from

home, well-funded organizations or state actors might be able to do so. Therefore, the resilience of blockchain is not absolute; it can be vulnerable to targeted manipulation depending on available computational resources, financial motivation, and intent. Ethereum's shift from proof-of-work to proof-of-stake in September 2022 shows an effort to decrease such vulnerabilities and strengthen the system.

(2) Record creation and keeping mechanism: this technology is designed to produce complete, definitive, and non-reproducible archival items using special encryption, thereby building a breach-resistant chain of proof of actions that occur.

(3) A decentralization mechanism: blockchain functions as a peer-to-peer distributed network, where participants typically act without the oversight of a central authority but instead operate autonomously while remaining coordinated through incentivization mechanisms. These incentives—often financial—raise ethical considerations, as the lack of supervision can blur the boundaries of responsible behavior. Although autonomy generally makes collusion more difficult, blockchain systems are not completely immune to coordinated manipulation. For example, a well-known vulnerability—the "51% attack"—happens when a single entity or a coalition controls the majority of the network's computational power, enabling it to alter the ledger and potentially validate fraudulent transactions. This challenges the idea that decentralization always guarantees integrity. However, under normal network conditions, the distributed nature of blockchain provides a solid basis for record validity and reduces many types of malicious activity [16, 9].

Blockchain systems utilize cryptographic file logs, rely on consent, and depend on distributive principles to finalize, complete, and stabilize records entered into the ledger [9]. Bhatia et al. (2020) [17] observed similar results in a recent study, which indicates that blockchain technology, when properly implemented, is a dependable solution for records management. It enables the recording of immutable transactions and offers independent control through digital documents that cannot be altered. Blockchain technology has been suggested as an effective solution for safeguarding privacy and security in managing records, transactions, and documents across various applications, such as payments, healthcare, and infrastructure developed for the Internet of Things (IoT) [18].

IV. Application of Blockchain in Records Management

The applications of blockchain technology in records management are a current research focus for many scholars, as this technology is increasingly viewed as a solution to recordkeeping issues where a reliable public ledger is needed. For example, Lemieux (2016) [3] uses blockchain applications in public identification services, title deed management, and financial transactions, arguing that this new technology can address longstanding problems related to information integrity and the reliability of active records. Franks (2020) [14], who analyzes case studies of blockchain applications in banking, healthcare, public services, and payment management, concludes that this technological solution aligns well with the fundamental principles of record management. At this point, it is important to note that blockchain applications, as discussed in more detail below, are often examined in relevant research literature in connection with "smart contracts" applications, i.e., digitized contracts with embedded IFTTT (if-this-then-that) code [19].

Among various blockchain applications in records management, those developed in healthcare stand out [20]. A limited but increasing number of studies have focused on this topic, highlighting blockchain's potential to improve patients' control over sensitive personal and medical data [21]. A study by Sunil & Sangamesh (2019) [22] describes specific uses of blockchain in healthcare, such as managing patients' medical histories, facilitating the pharmaceutical supply chain, and handling payments to healthcare providers. It argues that integrating blockchain into these functions provides important advantages in managing archival materials, including enhanced security, reliability, accessibility, and universal access. Harshini et al. (2019) [23] also introduce a human-centered record management model in healthcare using blockchain technology, emphasizing the need to implement smart contracts for exchanging medical data and increasing security in financial transactions between patients and healthcare providers.

Vaibhav et al. (2020) [24] confirm the previous need, arguing that implementing smart contracts in the healthcare industry significantly improves record management functions (e.g., insurance claims, clinical research, patient data security, pharmaceutical supply chain), leading to increased accuracy. Similarly, Sadiku et al. (2018) [25] contend that blockchain technology in health services is the right solution to enhance the quality of care provided to patients. Noh et al. (2017) [26] share similar findings, stating that blockchain platforms support the modern patient-centered healthcare approach. Specific blockchain applications in these functions are also documented in the literature. For example, Azaria et al. (2016) [27] analyzed the operation of MedRec, a new decentralized system for managing electronic patient records. This system gives patients access to a complete and unchangeable log of their records, while providers and healthcare organizations also have access. However, such shared access raises important ethical and legal concerns. For instance, insurance companies might use clinical data—such as a diabetes diagnosis—to enforce exclusion clauses or to increase premiums for related conditions like cardiovascular disease. This raises a critical question: is the sharing of clinical information truly in the patient's best interest, or does it mainly benefit insurers aiming to reduce financial risks?

Similarly, Medicalchain is another modern platform developed in the UK that uses encryption features (MedTokens) to handle payments and compensation in health services [28].

In addition to applications in healthcare, blockchain technology provides significant benefits in records management for public services [29]. For example, a study by Tasnim et al. (2018) [30] details a criminal record management platform designed to ensure maximum integrity and security of the data. By providing full access to authorities (law enforcement agencies and courts) and other users (e.g., airports, visa centers, police), this platform enhances capabilities for managing public criminal records, enabling prompt law enforcement and reducing the risk of corruption or breaches of criminal records in an environment of increased accountability.

The Vermont Digital Services (2019) [31] developed a blockchain platform for recording and managing land titles, which integrates previous electronic applications and allows responsible public bodies to control related transactions (e.g., sales, land repurposing), ensuring the reliability of active records. Similarly, a recent study by Thakur et al. (2020) [32] discusses the use of SAID technology to manage land ownership records in India, aiming to modernize the existing system by digitally connecting previously isolated services and improving the quality of property registration and transfer services. Comparable property management platforms are described both in the study by Lazuashvili et al. (2019) [33], focusing on the State of Georgia, and in a survey by Ramya et al. (2018) [34], covering Southeast Asian countries.

The potential of blockchain technology has been explored in other applications related to public administration, quality, and efficiency of public services, such as those related to handling and managing public certification documents (e.g., births and deaths), which can be made accessible to interested parties with the necessary security clearance [35]. Similar services have also been developed to record citizens' identities, property ownership, or migration flow data [36]. A study by Hyvärinen et al. (2017) [37] examines the application of blockchain technology to combat financial fraud or fraudulent waste of resources in public services, while another study by Elisa et al. (2018) [38] refers to respective applications offered by blockchain in identification services involving several governments, public and private entities.

Another area where blockchain technology and record management intersect is in finance, where suitable platforms can be used for activities such as transaction settlements, payments, and insurance claims [39, 40, 41], as well as in registration services (e.g., cadastre, civil register, tax register) [42, 43]. Recently, this new technology has become especially important in copyright registration services, where proving patent ownership and establishing registration priority are costly procedures for all parties involved [44]. Other applications can improve the effectiveness of e-voting services by securing them through data encryption functions [45], as well as record management related to donations and sponsorships to non-profit organizations [46].

V. Blockchain in Other Industries

Blockchain technology is directly used in supply chain management, helping to track products and enabling reliable process launches [47]. Shipping goods is another industry that benefits from improved records management by increasing transparency and security in maritime transport and related transactions [48]. Activities at ports and terminals (such as archiving and cargo availability information), customs authorities (like customs clearance of goods), intermediaries (such as archiving communications and transactions), and other bureaucratic procedures (including traceability) can see improvements in functionality, accuracy, and transparency thanks to these technologies [49]. Lastly, blockchain also impacts many areas of modern education, especially qualification certification services [50].

All these applications highlight the new possibilities offered by blockchain technology in records management, with the fundamental principle of ensuring maximum reliability and integrity for them [51].

VI. The Incompatibility of Blockchain and GDPR

However, it becomes clear that adopting legal personal data protection measures, such as the implementation of the GDPR in the EU, makes these applications problematic. The key innovation it introduces in e-government is not subject to central management and control functions [52]. Built on a peer-to-peer interaction framework, it is based on the principle of direct reciprocity between participants, allowing these functions to be performed within a single system without central mediators or third parties [53]. In such a system, transactions are recorded by any involved node, forming a chain where data is permanently stored and verifiable [21]. Indeed, in this system, all nodes in the network can record and control transactions, having direct access to the information in the blocks and their respective time sequences [54].

Blockchain technology is a secure database that uses asymmetric, complementary key encryption to protect data entered into the information chain [55]. The use of public and private keys along with hash functions enables the source of a specific message to be verified, ensuring its confidentiality, authenticity, and integrity [51].

Therefore, once validated by the nodes, the data entered cannot be altered or deleted, as it is recorded permanently. These features have historically conflicted with GDPR regulations, especially regarding the rights to rectification and erasure. However, recent advancements have proposed possible solutions. For example, the European Data Protection Board’s Guidelines 02/2025 highlight key compliance considerations for blockchain-based data processing, focusing on GDPR-compatible planning and accountability measures [56]. Moreover, technological innovations like chameleon hash functions have been introduced to allow data modification without compromising blockchain integrity, thereby supporting

GDPR's "right to be forgotten" [57]. Recent projects such as Olympus also investigate GDPR-compliant blockchain architectures using off-chain data storage and on-chain cryptographic verification, demonstrating that managing personal data under regulatory requirements is feasible. [58] These developments show a growing alignment between blockchain technology and data protection laws, indicating that practical legal and technical frameworks are starting to emerge.

The current regulatory framework was established between 2010 and 2014, and as a result, it does not account for emerging technologies such as blockchain, the Internet of Things (IoT), Artificial Intelligence (AI), or Smart Contracts [59]. Beyond this time limitation, skepticism among legislators has also arisen from the disruptive and decentralized nature of blockchain, which challenges traditional legal ideas of accountability, data ownership, and enforcement. Concerns about the opacity of consensus mechanisms, the potential for illegal use (e.g., money laundering or tax evasion), and the technical complexity of auditing distributed systems all contribute to hesitancy in adopting blockchain technology at the legislative level. Additionally, countries such as the United Kingdom and the United States have adopted data protection frameworks that reflect many of the GDPR's core principles, reinforcing a cautious regulatory approach toward blockchain implementations that could bypass centralized governance structures.

Indeed, in recent years, there has been intense research interest at both academic and practical levels regarding the relationship between blockchain and the GDPR, with their incompatibility attributed to two main reasons, as noted by a recent study conducted on behalf of the European Parliament [60]. The first reason concerns the fact that the GDPR is based on the premise that for each piece of personal data, there is at least one natural or legal person—the data controller—whom data subjects can approach to protect their rights under relevant EU data protection laws. In contrast, blockchain seeks information decentralization by replacing the central administrator with a network of different involved parties, making accountability for data use unclear. The second reason is that the GDPR enshrines the principle that personal data must be modifiable or erasable when necessary, as outlined in Article 16 (Right to Rectification) and Article 17 (Right to Erasure) of the Regulation [63]. Blockchain's immutability directly challenges these rights, creating a fundamental legal and functional incompatibility. However, blockchain makes such changes intentionally impossible to maintain data integrity and trust within the network [60].

The issues mentioned above have troubled many scholars and researchers, as discussed in the relevant literature. The conflict between blockchain and GDPR mainly revolves around three key points [61]. First, the "right to be forgotten" outlined in Article 17 of the GDPR requires entities holding personal data to delete it once the original purpose for collecting it has been fulfilled. This principle conflicts with one of blockchain's core features, which is the permanent storage of data and information entered into the network. Yaga et al. (2018) [62] explained that data is recorded on the blockchain in a permanent and unchangeable way, so removing it is not possible without "breaking" the chain. In other words, the architecture of this technology, which is based on cryptographic hash functions, does not allow modifying or tampering with data without disrupting its integrity and consistency [63].

According to Pizzetti (2017) [64], the immutability of the data recorded in this chain directly conflicts with the "right to be forgotten" introduced by the GDPR. The incompatibility between blockchain technology and data privacy is based on three fundamental assumptions.

(1) Data cannot be modified once inserted into a block, which conflicts with the right to delete and correct it according to article 17 of GDPR.

(2) Data is publicly accessible to each participant of the blockchain, a function that conflicts with the principles of confidentiality, accountability, and the designation of a central data processor.

(3) The data is stored indefinitely, which conflicts with GDPR principles related to purpose, necessity, and data minimization.

It becomes clear, then, that an organization that uses blockchain technology and chooses to comply with the data citizens' right to "be forgotten" faces a fundamental conflict with the core operating principles of this technology, undermining its credibility and validity [65].

The second point of incompatibility between blockchain and GDPR, as discussed in the relevant literature, relates to the fact that certain features of this technology conflict with "privacy by design" outlined in Article 25. Notably, Article 25 considers data protection as a set of measures that build in necessary guarantees of control and compliance with the regulation from the beginning when designing a data system [66]. Additionally, the inherent nature of blockchain requires storing data in the distributed ledger in a transparent and unchangeable manner, enabling each user to record a transaction and its associated value [67]. In this context, it has been argued that the transparent and publicly accessible nature of blockchain appears to present legal challenges. Under the current GDPR framework, data must be stored in a way that ensures, among other things, its confidentiality [68].

Given that personal data must be kept and processed discreetly, it goes without saying that it should only be accessible to authorized personnel. Although encryption and anonymization technologies can, to some extent, ensure compliance with these obligations, it is not yet clear whether this suffices to achieve full harmony between blockchain and GDPR [69]. A node containing personal data that may be visible to the public operates against the principle of availability; as such, data may be accessible to unauthorized users. Furthermore, if users can be identified from transaction data entries stored in a block, this conflicts with

the principle of confidentiality [70].

A foundational study by Biryukov et al. (2014) [71] demonstrated that users on the Bitcoin blockchain could be deanonymized through the analysis of pseudonymous addresses, even when such addresses exceeded 30 characters. This revelation exposed fundamental vulnerabilities in the blockchain's privacy assurances, especially within public, permissionless networks. These concerns are magnified in blockchain-based applications involving sensitive personal data, such as those in electronic health (e-health), where data confidentiality and user anonymity are crucial.

Recent research has reaffirmed and expanded on these concerns. Studies conducted as recently as 2023 continue to show that user identification through network-layer analysis remains feasible, indicating that the issue persists despite increased awareness and technical countermeasures. In response, new privacy-preserving frameworks have been proposed to protect sensitive information in healthcare systems.

For example, Alabdulatif et al. (2025) [73] introduced a blockchain-based authentication model using Ethereum smart contracts, blind signatures, and Proof of Authority (PoA) consensus to enhance the privacy, scalability, and efficiency of e-health systems. Likewise, other models incorporating self-sovereign identity (SSI), decentralized identifiers (DIDs), and attribute-based encryption (ABE) have been developed to enable granular, content-based access to encrypted medical data stored off-chain in decentralized file systems. These advancements highlight a growing focus on balancing blockchain's transparency with the strict privacy requirements imposed by data protection laws such as the GDPR.

The third point of incompatibility, which is the research focus of this review, concerns the distribution of data processing responsibility [74]. As Humbeeck (2019) [75] states, the fundamental principle of having a recognizable central entity that is legally responsible for data processing—embedded in the GDPR—and the core feature of blockchain technology that addresses this need are two conflicting perspectives that raise both legal and practical concerns. The decentralized nature of blockchain decision-making and data processing challenges the obligations placed on legal entities or individual persons by the current regulatory framework [76].

Indeed, the GDPR emphasizes data controllers as the main entities responsible for performing specific tasks and holding responsibilities for implementing necessary technical and organizational measures to protect personal data. However, the decentralized nature of blockchain makes it nearly impossible to identify who is accountable for these obligations under the GDPR. The core of this incompatibility mainly relates to how data should be protected [77]. In other words, the European legislature assumes that, in case of security breaches, regulatory authorities should hold a public or private entity accountable. Conversely, the very nature of blockchain removes the need for a "trusted third party," as trust is built collectively and there is no central authority managing the system responsible for storing and processing data [61].

The nodes participating in the blockchain's distributed ledger do not and cannot have full control over the functions within the system. In this context, the data controller defined by law is replaced by the blockchain's architecture and cryptographic functions [78]. While these may be more reliable for achieving secure and comprehensive data management than a legal or natural person, as required by the GDPR, they are practically difficult to hold accountable. Therefore, under this technological design, it is extremely challenging to identify the responsible "controller" under Article 4 of the Regulation [80], raising ethical concerns alongside legal ones. Given the limited influence of individual nodes, it would be unfair or even impossible to impose the GDPR obligations on data controllers [70], especially since most blockchain developers view hashing and anonymity as "impervious" doctrines of this technology [80].80].

VII. PROPOSALS

Reviewing academic literature shows ongoing conflicts between blockchain technology and the GDPR, especially regarding data erasure, accountability, and control. However, recent research is increasingly focused on solving these issues through legal and technological solutions. As mentioned earlier, efforts to make blockchain compatible with the GDPR include designating a legal entity—such as a Trusted Third Party (TTP)—to act as a data controller within the network [81]. This entity would be responsible for verifying the accuracy of personal data and ensuring GDPR compliance [82].

One area of research supports redesigning or adapting blockchain systems to better meet legal requirements, particularly concerning the right to be forgotten. Pollicino and De Gregorio (2017) [83] advocate for a compromise-based approach, while Dorri et al. (2019) [84] highlight that any data deletion process must preserve the integrity of the blockchain's structure. In this context, the concept of redactable blockchains—initially introduced by Ateniese et al. (2017) [85] using chameleon hash functions—has gained popularity. This enables selective data modification without compromising the cryptographic integrity of the chain.

Recent developments have tested different variations of this idea. For instance, Vukolić et al. (2024) [86] introduced updated chameleon hash functions to create GDPR-compliant blockchain designs while reducing the risk of misuse. Similarly, Olympus, a 2024 project by Ferrer et al. [87], uses hybrid off-chain storage with on-chain cryptographic proofs, enabling data to be erased from the system while maintaining blockchain auditability and integrity.

Legal scholars such as Pagallo et al. (2018) [88] have recognized that although these systems technically enable

data removal, implementation challenges still exist, especially if the redesign is attempted after a blockchain network is already in use [89]. Additionally, the continued existence of old copies of the blockchain remains an issue, even with architectures that can be modified [90].

To bypass on-chain limitations, a common design pattern involves storing personal data off-chain, with only the cryptographic hashes kept on-chain. Herian (2018) [76] endorses this approach as a GDPR-compliant strategy, and it is reflected in technical models by Bourka & Drogkaris (2018) [91] and Rieger et al. (2019) [2]. However, this also depends on a TTP, which some argue diminishes the decentralized nature of blockchain [89].

Addressing this concern, Eberhardt & Tai (2017) [92] and recently Ferrer et al. (2024) [87] proposed privacy-preserving off-chain architectures using zero-knowledge proofs, attribute-based encryption, and self-sovereign identity wallets, which minimize central control while improving compliance. These developments represent a merging of blockchain innovation with evolving data protection frameworks, showing that legal and technical interoperability is becoming more achievable.able.

VIII. Conclusions

The interaction between blockchain technology and the General Data Protection Regulation (GDPR) continues to present major challenges, especially regarding the storage and handling of personal data. While off-chain storage provides a possible solution by keeping personal data outside the immutable blockchain ledger, storing hash values on-chain that reference this data raises questions about whether these hashes qualify as personal data under GDPR. Currently, there is no clear consensus on this issue, leading to ongoing legal uncertainties [93, 94].

Recent advancements aim to bridge this gap. For example, the Olympus project showcases a GDPR-compliant blockchain system that uses off-chain storage for personal data while preserving on-chain cryptographic proofs to ensure data integrity and auditability [87]. This method aligns with the European Data Protection Board's latest recommendations [95], which offer guidance on personal data processing with blockchain, indicating that hybrid architectures present promising compliance solutions.

Furthermore, innovative frameworks like "Blockchain-enabled Trustworthy Federated Unlearning" have been introduced to fulfill the "right to be forgotten" in AI-integrated blockchain systems, allowing verifiable removal of user data contributions without compromising audit trails [96]. Such techniques provide a flexible way to enforce data subject rights even in decentralized settings.

In light of these developments, this paper proposes a mechanism that guarantees the right to be forgotten for data stored on-chain. The proposed system would use a hybrid approach, combining off-chain storage for personal data with on-chain references, and would include features to automatically assign and manage data controllers and processors. This design aims to uphold data protection principles while taking advantage of blockchain's inherent benefits, thereby supporting the development of legally compliant and technologically strong data management systems.

IX. References

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Journal of Integrated Information Management electronic journal

Historical Medical Archives and Libraries: The Case of Historical Archive of Eginitio Hospital

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Article Info
Article history:
Received 27 June 2025
Accepted 10 July 2025

http://dx.doi.org/10.26265/jiim.v10i1.41913

Abstract:

Purpose *- One of the goals of modern nursing institutions should be the preservation and promotion of their historical archives, as they represent the primary source of local medical history and society. Medical archives have historical importance and can document the knowledge, the beliefs of healthcare professionals, the development of health and medicine. The purpose of this article is to highlight the importance of the preservation of historical medical archives and the leading role of the hospital library to their management and promotion, as a golden value-added service, according to the MLA Standards of Practice for Hospital Libraries and Librarians, 2022.*

Design/methodology/approach *- This article will present the challenges that may arise during the establishment and management of a historical medical archive. It will also cover the digitization process of a historical medical archive and the importance of data protection, particularly patient privacy and security. The case of the Historical Archive of Eginitio Hospital and the management by its library will be presented. It is an ambitious and challenging project in progress that will preserve the history of the nursing institution, the historical revolution of neurology and psychiatry and the broader societal impact of these fields.*

Findings *- The hospital library, by undertaking the management of the institution's historical archive, offers an added value service, which enhances its profile and visibility and highlights it as a place of historical information and acquires a new demanding educational role. As a project, it is not easy because it requires knowledge of archive maintenance and organization, promotion and visibility of the archive to the researchers and to the public, which consequently demands sufficient staff and significant funding.*

Originality/value *- This paper introduces, for the first time, the issue of managing and organization of a historical hospital archive by its library in Greece.*

Index Terms — Historical Medical Archives, Hospital Libraries, Hospital Records, Cultural Heritage, Digitization

I. INTRODUCTION

The preservation of historical medical archives is a significant concern for the research community as these offer primary and valuable resources for researchers and historians and can lead to new treatments and approaches to healthcare [1, 7]. They provide unique items and dynamic tools for preserving the memory, documenting the medical history, social reforms, providing evidence of the history, goals, values and actions of nursing institutions and are part of national cultural heritage and collective memory [1-4].

Archives can represent human activities and memories of their time but also have the potential to influence social norms and create new social and cultural attempts, like virtual museums, digital collections, storytelling etc. [1]. They have significant historical value, as they document the beliefs of healthcare professionals, the development of medical science and society and contribute to the understanding of evolution of medical knowledge and societal perceptions regarding health, management and treatment of each disease [1].

Like most archival collections, contain various documents (Fig. 1), documents of foundation, legislation, administration, correspondence, official records, annual budget, reports and inventories, architectural drawings, photographic and audiovisual material, scientific publications, biographical material, medical records of past cases, patient files, meetings, nursing school artifacts, brochures, ephemera, laboratory test results, x-rays, medicine bottles, personal doctors archives, recorded lessons, medical equipment etc. [1, 5].

II. HISTORICAL MEDICAL ARCHIVES

A. Why preserve a medical archive

By creating a historical medical archive, the operation, development, historical significance and changes of a nursing institution are preserved for future generations and documented, while the creation of a digital medical archive adds value to the institution itself and contributes to its marketing [3, 5, 6]. Finally, it serves as the permanent repository and historical reference and information center for documents that refer to the history and memory of the institution and medical profession in general [2]. For all these reasons it is essential that historical medical archives are protected and wisely used, as they are irreplaceable material [1, 2, 7].

By the preservation of historical medical records, researchers can find valuable information such as when the first patient was admitted to the hospital, which disease was the most common, how and if the disease was linked to ethnicity, age, residence, profession, gender etc. [7, 8]. Researchers can find photographs of clinics and patients, notes and documents about administration, medical equipment, medication, examinations, development of

clinical practices, social behaviors, bills, treatments, nutrition, experiences, etc. [7, 8].

In addition, researchers can sociologically and historically study the evolution of medical terminology, study hereditary disease profiles, retrieve personal information of patients and families, demographic data, can linguistically study the patient notes and understand the skills, behavior and level of education of patients, social class, etc. [7, 8].

Fig. 1. Content within a hospital historical archive

B. Hospital Libraries and Archives

It is a common international practice for the library of the hospital to undertake the role of collection, management and preservation of the historical medical archive, which offers the library a value-added service that will eventually increase and enhance its profile and visibility, inside and outside the hospital [3, 5, 8]. The Hospital Library, by taking over the management of the "Historical Archive", acquires a new demanding educational role and becomes a place of historical information, and not only a place of scientific medical information [8].

According to the "Standards of practice for hospital libraries and librarians (2022)" the maintenance and collection of hospital archives ranks hospital library at a gold level of services [9]. However, the disadvantage for the library is obvious, namely the additional work and the legacy of an unorganized material, which requires knowledge of organizing and maintaining archives [8]. In Greece, it is difficult for a library to maintain an archive because most libraries are understaffed and lack significant funding.

C. Challenges

The first step and challenge in founding a historical hospital archive is to gather the "history" and locate the documents, from warehouses, offices, corridors etc. [4]. There is not a specific way of establishing it, but each one follows its own policy, methodology and criteria for including documents in the archive [4].

The next step in founding an archive is to find the adequate place for storing and preserving. The space for a historical hospital archive can be in different places. It could be within the hospital's library, a separate dedicated archive space, or even outside the hospital altogether, yet it must have the appropriate environmental conditions for the preservation of the material [2].

The archivist should use archival conservation techniques to rescue the material from damage [2]. Finally, funding is crucial for establishing and maintaining archives, as budgets are a common limitation in archival projects. Securing adequate funding allows for proper preservation, organization, and accessibility of historical materials [2, 5].

D. Promotion of a historical medical archive

Nursing institutions that wish to preserve their archives and keep their history present in the memory of the community to which they belong, but also to a wider public, should frequently organize activities with the aim of promoting them [2]. It is important to organize promotional, educational programs and exhibitions to promote interest in the archive and to ensure access, since the information it contains is pivotal for the potential creation of new communities and cultural endeavors [1, 2].

In addition, for visibility reasons, the archive should appear on the website of the library or nursing institution, which will describe its services, mission and actions [2]. The manager of the archive should also collaborate closely with the administration and staff to promote the new service, for example via the hospital's newsletter or information brochures [2]. The archival project can strengthened and supplemented with oral history of people that influenced the hospital [2].

E. Accessibility

For the library of a nursing institution, the most important mission should be the accessibility to the historical archive. However, because hospital archives and especially patient records contain sensitive information and personal data, and thus they should approached with care, respect, and consideration of ethical issues and legislation regarding privacy, data protection, and confidentiality, especially if they will be visible through digitization [1, 3, 7]. The need for appropriate preservation of records and the development of access policies should balance with the need for research, protection of personal rights of the individuals involved [7]. Internal regulations and application forms are vital for establishing who can access the archives, under what conditions and for what reasons ensuring integrity and preservation.

F. Digitization

Nowadays, the digitization of cultural heritage has been a more important task than ever and therefore there is a significant need to digitize historical hospital archives having considerable historical, cultural and scientific value, which can effectively preserved in perpetuity [6, 7]. Digitization projects, tools and infrastructures have made it possible to preserve and share cultural heritage with a wider audience, preserving important and sensitive documents at risk and creating valuable resources for scholars in the future [6, 7].

The purpose of digitization is to locate the material and make it accessible from anywhere and at any time, while at the same time allowing for better and easier examination and analysis of the archival material [3]. In addition,

digitization increases the accessibility and use of the material, which becomes more accessible and traceable, and hence it can now reach new audiences, beyond the community of the nursing institution itself, while at the same time it can shared at a national and international level [3, 5]. With digitization, the researcher does not need to have the original document and so instead of traveling to the archive, the archive comes to the researcher [3].

In addition, the challenges of preserving handwritten documents and their correct transcription require the collaboration of experts and the use of advanced technologies [7]. With the help of an AI (Artificial Intelligence) model, researchers can find answers to questions based on historical perspectives and this will enhance research and understanding of medical science [7].

III. HISTORICAL ARCHIVE OF EGINITIO HOSPITAL

A. Eginitio Hospital

Eginitio Hospital (Fig. 2) founded by the initiative of the first Professor Michael Katsaras in 1904 thanks to the bequest of Dionysius and Helen Eginitis [10]. It initially housed the Neuropsychiatry headquarters and much later (1963) was separated in two clinics, those of A' Neurology and A' Psychiatry of the National and Kapodistrian University of Athens [10]. As a university hospital, it offers educational and postgraduate programs, develops and promotes medical research through many laboratories and special units.

Fig. 2. Photo of Eginitio Hospital

B. About Historical Archive

According to the Organization Chart of Eginitio Hospital, the Patient Admission Office and Archive manages the active Archive. Fifteen years ago, Professor of Neurology I. Evdokimidis had the idea of establishing the historical archive of our hospital. Professor Evdokimidis initially determined the documentary and informational value of the archival material and selected the documents that today constitute the Historical Archive of Eginitio Hospital, with the aim of preserving them in perpetuity.

This was a difficult and time-consuming undertaking, which did not always have the support it deserved, and it is still an ongoing procedure. In recent years, this initiative has strengthened with the establishment of the Historical Archive Committee, which consists of Emeritus Professor of Neurology I. Evdokimidis, Emeritus Professor of Psychiatry D. Ploumbidis and Professor of Neurology C. Potagas. Since 2023, the library has undertaken the management and maintenance of the Historical Archive, in collaboration with the Committee.

C. Space of the Historical Archive

The records and files of the historical archive were in various places in the hospital, due to lack of space and exposed to damaging factors (dust, humidity, insects, etc.). In 2017, the archive placed in a special space inside the old hospital building. Initially the archival material placed without proper organization in wooden bookcases until October 2023, which then replaced by metal bookcases that lock and ensure better protection from damaging factors (Fig. 3).

Fig. 3. Space of the Historical Archive before and after management

D. Content of the Historical Archive

The Historical Archive includes files or books, from 1904 to 1992: inpatient and outpatient registrations, clinical files, outpatient clinical activity books, accounting books, books of expenses, books of incoming and outgoing patients and patient files, books of drugs, books of treatment, books of laboratory tests, books of draft patient histories, books of daily reports, protocols of incoming and outgoing documents, patient name indices, patient diagnosis books, student exercise book, electroshock books, cardio shock books, EEG books, supplies books, nutrition books, warehouse and furniture books, emergency books, nursing books, outpatient history books.

E. Preservation and maintenance of Archival Material

The archival material was in good condition, despite its inappropriate previous storage. The folders cleaned from dust and harmful and unnecessary objects, which considered dangerous for the oxidation and deterioration of the documents, removed. Medical gloves and microfiber cloths used for the procedure; harmed folders were replaced with new ones.

Most of the documents were in special file folders and very few documents were loose. The loose documents placed in special file folders, in which their content indicated, following the terminology used by the staff of the Patient Admission Office. When the digitization of the material is complete, the material will be stored in appropriate paper archival storage boxes for greater protection.

F. Access record and arrangement

The first recording of the material carried out by a team of Historical Archive of the National and Kapodistrian University of Athens in Microsoft Access. The following

information entered: accession number, classification number, folder name, organization, content, chronology, old name title, material condition, number of file sheets. Each folder obtained a unique classification number. The existing subject categories maintained, and the file classification numbers assigned according to them.

After the recording of the archival material, the classification number labeled on the spine and cover of the files. The files rearranged and classified according to the classification numbers. During the summer of 2023, with the valuable experience and assistance of historian and researcher Despo Kritsotaki of Academy of Athens completed the data recording of our archival material. The data entry of the content into Microsoft Access facilitated the processing of the data and allowed easy and quick access for historians and researchers. This form of accession record became the base for the later functions of arrangement and description of the archive.

G. Finding Aids

By the end of the recording of the archive, three indices created in Microsoft Excel format (Fig. 4), as supplementary research tools, to facilitate researchers and historians:

- Numerical index: according to classification number
- Alphabetical index: according to the File Title/Subject
- Chronological index: according to the File's chronologies

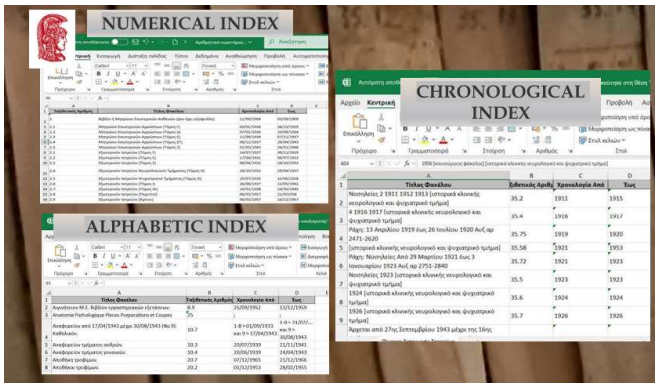

Fig. 4. Indices of Historical Archive

Our archive offers also to researchers the possibility to use oral history tools for a more complete historical research of nursing institutions [11]. A research team of professors Evdokimidis, Lekka, Ploumbidis and historian and researcher Despo Kritsotaki interviewed members of medical, nursing and administrative staff of Eginitio Hospital, who worked during the period 1950-1979, in order to establish an oral history archive of our hospital [11].

H. Database Celifos

Our hospital, on the initiative of the Committee of Professors D. Ploumbidis, I. Evdokimidis and C. Potagas, secured a grant from the I. Martinos Foundation for the digitization of part of the Historical Archive. The digitization began in June 2024 and completed in May 2025. In the first phase, only the records of in-house patients digitized, for the period of 1904-1955.

Private company has created a database (Fig. 5) that researchers can search using filters and access digital copies of patient records. Thus, researchers can search using filters that include place of birth, place of residence, occupation, diagnosis, outcome, hospitalizations, and visits. Researchers can also use the database within the hospital, either in the Historical Archive or in the Hospital Library, having access to the full content of the files, but without knowing the names of the patients. Furthermore, the database is remotely available. In the first year, it will be available through the company that digitized the archival material and accessed via the hospital's website.

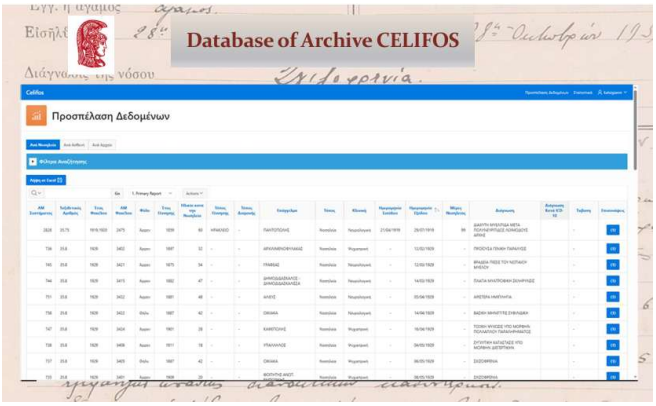

Fig. 5. Celifos database

I. Accessibility

Researchers, historians and anyone wishing to study our archival material may have access to it after completing the Researcher's Application. With the Application, researchers must comply with the Regulation on the Operation of the Historical Archive and the Regulation of the European Union for the protection of personal data and sensitive information. Then the application submitted for approval to the Historical Archive Committee, who is also responsible for the management of the historical archive.

Researchers can study the physical archival material in the Historical Archive or in the library, by appointment from Monday to Friday from 8.00 a.m. to 13.30 p.m. Those interested in using the database within the hospital should complete the Researcher's Application, while if they wish to have remote access to the full content of the database, in addition to the application, they should create a user account for a specific access period.

J. Open Access Catalog

The Historical Archive is also available through the library's open access catalog at openABEKT (Fig. 6) of the Eginitio Hospital Library. For each folder a bibliographic record is created, with full documentation and description with link to the digital archive for the digitized material (https://eginitiolib.openabekt.gr/el/collections/685253fb8140fb717e00622a). For subject indexing of the records was used the thesaurus of medical terms of National Documentation Center and subject headings of National Library, or translation of Medical Subject Headings of NLM.

After the subject indexing of the archival material, a new alphabetical subject index created according to the subject terms.

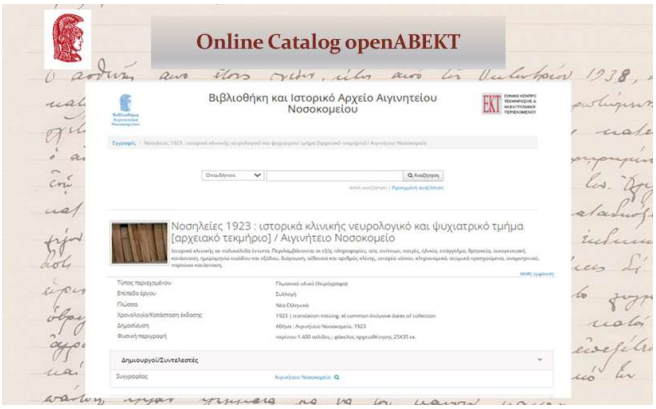

Fig. 6. A bibliographic record of a historical archive folder

K. Importance of the Historical Archive of Eginitio Hospital

The medical files and administrative documents that currently kept in our Historical Archive are evidence of the life and history of our hospital. They bring to light stories and discoveries related to the academic and scientific world of the past and illuminate aspects of the sciences of Neurology and Psychiatry.

Today, with the preservation of the Historical Archive of Eginitio Hospital, researchers, historians, students and all citizens can carry out research, studies and dissertations, utilizing valuable and rare archival material. They can study diseases, demographic and nosological characteristics of patients, where without the preservation and access to this primary source, the study of the history of medicine and research would be impossible.

IV. Conclusion

In conclusion, historical medical archives are part of the national cultural heritage, they contribute to the preservation of the collective memory of society and the understanding of the history of medicine [7]. The creation of electronic patient records is important, but equally important is the preservation of older records and archives for historical and other reasons. By rescuing and providing access to these records, we can honor the diversity of human experiences and promote a more inclusive understanding of our cultural heritage [7].

Hospitals in Greece should recognize the need to preserve and digitize their historical archives, as they offer valuable information and documentation. With the help of new technologies and artificial intelligence, answers to important questions can be answered, which will be based on the sources of historical archives of health. For the implementation of this project, there should be close and harmonious cooperation between different specialties, archivists, librarians, historians, medical, nursing staff and administration, with the aim of better management and promotion of the archives.

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Journal of Integrated Information Management electronic journal

Disruptive Computational Technologies in Electronic Medical Records Management

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Article Info

Article history:
Received 14 June 2025
Received in revised form 24 June 2025
Accepted 02 July 2025

http://dx.doi.org/10.26265/jiim.v10i1.41805

Abstract:

Purpose – *The adoption of disruptive computing technologies in hospital administration services has transformed the landscape of medical data and information handling. Electronic medical records (EMRs) contain patients' health data generated in medical practices. This data can be converted into health information that pertains to individual patient health status, monitoring patient well-being, processing payments and financial transactions, providing statistics and demographics, and facilitating quality control of medical services.*

Design/methodology/approach – *This narrative literature review summarizes the current theoretical and practical frameworks for electronic medical record systems (EMRS), database structures, and information searching and retrieval strategies. The resources have been published in peer-reviewed journals indexed in PubMed, Scopus, Web of Science, and iCite databases.*

Findings – *EMR data stored in relational databases (RDB) are managed by RDB management systems (RDBMS) using structured query language (SQL) or not only SQL (NoSQL). Their efficient operation and content accuracy can be achieved by applying rules that ensure the atomicity and consistency of each transaction with the database, the isolation and synchronized control of the database, and the durability of the system against failures or errors. Current disruptive computational technologies, deep learning algorithms, artificial neural networks, recurrent neural networks (RNN), convoluted neural networks (CNN), and generative large language models (LLM) artificial intelligence (AI) systems can be utilized in these systems to uncover knowledge by answering complex health information queries.*

Originality/value – *Implementing AI systems in EMR RDBMS will enhance computer-assisted decision-making for various healthcare stakeholders, including medical practitioners, patients, and caregivers. From a clinical perspective, these systems may contribute equally to evidence-based and precision medicine. We will discuss the best practical and ethical considerations for their routine application.*

Index Terms — Electronic Medical Record, Electronic Medical Record System, Electronic Patient Record, Health Information Science, Computer-Assisted Medical Decision Making.

I. Introduction

The practice of maintaining medical records is a widely accepted clinical practice, documented in ancient Egyptian and Greek papyri as early as the 16th and 5th centuries BC, respectively [1, 2]. These case reports, particularly those from the Hippocratic Corpus, were shared among physicians in both the Arabic and Western worlds, establishing the foundations of medical pathology. Since the early 19th century AD, physicians have systematically documented clinical histories in their notebooks [3]. Initially, hospital staff and administrative personnel adopted and managed this process for inpatient cases by recording admissions and discharges. However, they gradually included additional data, such as patients' symptoms, physical examinations, drug administration, and surgical or other interventions. This administrative hospital bookkeeping has proven to offer additional educational value, particularly for teaching hospitals [4]. The copying of selected case reports from medical records involved transferring medical and surgical volumes to the hospitals' libraries [5].

Nevertheless, a clear distinction exists between medical data and health information. Both data and information are fundamental concepts in librarianship and information science, often used interchangeably in scientific literature. They serve as essential building blocks for producing knowledge after logical interpretation. However, these concepts are distinct, each with different organization, meaning, and roles.

Biomedical data refers to raw, unorganized, and unprocessed text, numbers, graphics, images, sounds, or videos that provide qualitative descriptions, figures, or quantitative data. These data exist independently in biomedicine, representing snapshots of clinical, laboratory, or experimental processes that describe biological parameters both objectively and subjectively without interpretation. The latter directly relates to the subjective description of a clinical case and diagnosis by the physician or the patient's self-report of symptoms and suffering. Although medical data possesses direct didactic, educational, and training value, it lacks context, reference, and meaning [5]. To acquire these aspects, appropriate processing or analysis is necessary, transforming medical data into health

information.

Health information is essential for healthcare providers to follow up on patients' health and deliver effective care. When aggregated, it can also help to understand population health trends and the effectiveness of medical interventions. It can improve healthcare by monitoring common patterns in illnesses, treatments, and outcomes. Clinical audits, service ratings, and useful statistics are all components of health information for healthcare organizations, hospitals, or insurance agencies.

Here, we will discuss the evolution of adopting disruptive computational technologies in healthcare over the past four and a half decades.

II. Related Work

The scientific value of the patient's medical record, beyond its administrative practical importance, has been well recognized and detailed in statistical reports from hospitals since the early 19th century [4]. It was the promise of high-throughput analytical power and communication that initiated the era of computer applications in medicine. From the perspective of information scientists, regarding hardware, software, and algorithm generation, computer applications in medicine are not fundamentally different from those in other fields of knowledge. However, medical informatics significantly surpasses computer applications in medicine, as it is positioned at the core of biomedical research and the generation of health information. The practical application of this disruptive technology includes communication and registration, data storage and retrieval, automation and computation, decision-making, image processing and pattern recognition, process control, systems regulation, simulation, and model building [6]. Notably, this exact framework, as described by the medical informatics pioneers in 1984, remains unchanged to this day.

The transition from a paper-based system to the computing era required significant financial investments, infrastructure changes, training, and familiarization with new systems for all stakeholders: physicians, nurses, paramedics, other healthcare providers, administrative personnel, patients, families, and caregivers. The digitization of current and past medical records was monumental in scale. Despite the challenges, by the mid-1980s, the introduction of computer-based patient records replaced the use of paper and the physical storage of medical records in hospitals. Soon, the use of electronic medical records (EMRs) by medical institutions became so common in the US that it was broadly implemented within a decade, leading to revisions in commentaries on standard healthcare services [7]. The need to adopt standard, structured metadata formats to effectively describe EMR data was urgent. Metadata can be descriptive, detailing a data resource for discovery and identification; structural, illustrating the composition of complex entities and how their elements are coordinated; or administrative, providing information on managing a resource, such as creation time, file type, and other relevant technical information.

Guidelines for electronic patient registries were introduced to evaluate patient outcomes in an organized manner, utilizing observational clinical examination methods, uniform delivery of laboratory-observed measurements, and descriptive definitions of diseases, conditions, symptoms, and therapeutic interventions. The patient registry database delineates the files derived from such a registry [8]. The impact of these technologies extended beyond the narrow hospital environment to be applied to nursing homes [9].

Medical informatics can be applied to these datasets to infer health information from structured biomedical data. Considering the scope of the collection and the objectives of the medical informatics analysis, three distinct types can be identified. When the analysis focuses on the primary reason for collecting the data, it is known as primary data analysis. If the purpose of the analysis differs, it is termed secondary data analysis. Tertiary analysis involves annotation, filtering, and data interpretation to draw comprehensive functional, quality, and post-analytical logical conclusions. For example, blood pressure readings can be used primarily to diagnose hypertension in individual patients. However, if a patient's postoperative pressure measurement intervals are recorded, this can be used secondarily to indicate the quality of nursing services in a hospital. The broader association of blood pressure readings with clinical genetics, such as next-generation sequencing analysis, provides a means for complex interpretation of genetically heterogeneous disorders, including hypertension [10].

Thirty years ago, it was clear that maintaining electronic medical records (EMRs) in-house did not promote cross-organizational communication and information exchange. The data stored and aggregated in institutional silos of electronic medical record systems (EMRSs) were difficult to share or reuse for clinical or research purposes. Hypertext-based design improved computational capabilities by branching the content, index, and keyword references [11]. The introduction of web technology marked a communication breakthrough that paved the way for the desilofication of health information. Naturally, unifying coding standards for medical data has been and remains essential for aligning the information derived from different electronic medical record systems (EMRSs) created by various vendors [12].

Since the turn of the century, numerous disruptive technologies have emerged in computer science and medical informatics, such as mobile edge computing, telemedicine, smart mobile devices, web 2.0, the semantic web, the Internet of Things (IoT), cloud-edge computing, data encryption, blockchain, machine learning, and generative artificial intelligence (AI) models. The following sections will examine the literature on the impact of these technologies on in-house and outsourced electronic medical record management and analysis.

III. Methodology

A thorough investigation of multiple bibliographic databases was conducted to explore the computational technologies used in medical informatics that develop electronic medical or health records (EMRs or EHRs), clinical and laboratory analyses, medical imaging, biomedical research, epidemiology, patient-centered care, clinical decision-making, and collaboration among healthcare providers.

A. Research Questions

This study aims to address specific questions regarding the application of disruptive computational technologies in routine electronic medical records management:

- RQ1: What are the research areas involved, and what are the topics of research focus?
- RQ2: What computing technological advances are utilized in healthcare?

B. Search Strategy Design

Four bibliographic databases were used in the search strategy:

- PubMed (https://pubmed.ncbi.nlm.nih.gov/),
- Web of Science (https://www.webofscience.com/),
- Scopus (https://www.scopus.com/), and
- iCite (https://icite.od.nih.gov/).

The applied keywords of interest included: “electronic medical record systems,” “relational databases management systems,” “electronic patient record,” and “computation” within the Title, Abstract, Keywords, or Topics, without institutional or country affiliation, or chronological restrictions. Additional keywords were utilized for post hoc investigations of specific subjects: “medical information system(s),” “mobile edge computing,” “telemedicine,” “mobile healthcare,” “emergency medicine,” “personalized medicine,” “evidence-based medicine,” “epidemic(s),” “pandemic(s),” “COVID-19,” “smart mobile devices,” “web 2.0,” “social media,” “blogging,” “microblogging,” “semantic web,” “ontologies,” “Internet of Things,” “cloud computing,” “data encryption,” “blockchain,” “machine learning,” “deep learning,” “artificial intelligence,” and “Large Language Model(s),” or “generative artificial intelligence.” All bibliographic research was conducted in accordance with the formatting requirements of the relevant bibliographic database, employing advanced query syntax, Boolean operators, field codes, and auxiliary filters such as publication date range, subject area, document type, keywords, affiliation, and language. PubMed and iCite interrogation yield the same research results; however, the contexts of the PubMed and iCite databases, as well as their deliverables, differ. PubMed results comprise titles, abstracts, and bibliographic metadata, whereas iCite results encompass bibliometric metadata, including paper influence, translation into applied clinical practices, and open citations. All search results were extracted and downloaded as comma-separated values (CSV) or text files. The last time the databases were accessed was on June 6, 2025.

C. Data Analysis

The collected data was combined and delivered in worksheets for further analysis. VOSviewer version 1.6.20 was utilized for bibliographic analysis and visualization of trends. Full counting was employed to calculate the link strength. Descriptive statistics and Latent Dirichlet Allocation (LDA) topic modeling were applied. The iCite translation module was used to estimate the levels of clinically applied research articles, which are more closely related to human subjects compared to animal models or molecular/cellular biology research patterns, based on the number of Medical Subject Headings (MeSH) terms that fall into each category.

IV. Results

A total of 75,593 documents were identified, of which 30,988 remained after duplicates were removed. Among these, 9,522 papers were included based on their relevance to the research query (Figure 1). Relevance estimation was conducted by sorting the retrieved records according to the presence of query terms in their titles, abstracts, or keywords. More than half of these publications have been issued from 2021 to the present (Figure 2).

Research Areas	Record Count	% of 9,522 docs
Health Care Sciences Services	6631	69.639
Mathematical Computational Biology	5785	60.754
Computer Science	4148	43.562
Mathematics	3648	38.311
Medical Informatics	3228	33.9
Communication	2139	22.464
General Internal Medicine	1903	19.985
Information Science Library Science	1746	18.336
Science Technology Other Topics	1712	17.979
Pharmacology Pharmacy	1454	15.27
Cardiovascular System Cardiology	1370	14.388
Engineering	1331	13.978
Geriatrics Gerontology	1271	13.348
Public Environmental Occupational Health	1234	12.959
Radiology Nuclear Medicine Medical Imaging	1133	11.899

Table 1. The top 15 research areas within the bibliographic portfolio using Web of Science.

A. Research areas and topics involved

The research areas related to the adoption of disruptive computer technologies in biomedicine (Table 1) highlight the multidisciplinary nature of this process.

Topics	Record Count	% of 9,522 docs
Computational Biology	4030	42.323
Human Medicine Medical Sciences	3261	34.247
Computer Applications	1745	18.326
Medical Sciences	1349	14.167
Models And Simulations	1260	13.233
Mathematical Biology	1199	12.592
Human Medicine	941	9.882
Pharmacology	786	8.255
Cardiovascular Medicine	766	8.045
Methods And Techniques	659	6.921
Allied Medical Sciences	597	6.27
Oncology	528	5.545
Infection	509	5.346
Clinical Immunology	481	5.051
Information Studies	444	4.663

Table 2. The top 15 topics identified in the bibliographic portfolio, according to the Web of Science.

The research areas related to the adoption of disruptive computer technologies in biomedicine (Table 1) highlight the multidisciplinary nature of this process. The objective is to enhance healthcare services, but achieving this requires collaborations with computational biology, computer science, mathematics, medical librarianship, and information science. In terms of applications, medical informatics emphasizes the communication of general internal medicine and pharmacological evidence, particularly in cardiology, geriatrics, public environmental occupational health, medical imaging, epidemiology, oncology, psychology, immunology, neurosciences, pediatrics, pulmonology, genetics, endocrinology and metabolism, gastroenterology, hematology, surgery, urology, critical care medicine, and obstetrics and gynecology. Beyond the confines of applied clinical research, EMR computational algorithmic applications are involved in sociology and business economics, in-house logistics, and the outsourcing of healthcare services and their financial administration.

Nearly 80% of the papers are original research investigations, with 10% of them being conference proceedings, 8% being reviews, and 2% being applied clinical trials of computational applications. Although this finding suggests poor penetration of disruptive computational technologies in medical practice, the iCite analysis of the bibliography indicates that from 1980 to the present, nearly all reports relate to human patients and not to animal experimental models or basic molecular biology research, as reflected by the number of related MeSH terms reported in papers. Indeed, this observation is consistent with the topics analysis (Table 2), which investigates the topics reported in the bibliographic portfolio. Human medicine is the leading concept in 90% of the papers in the collection, closely followed by computational methodologies. Among the specific concepts, models and simulations lead at 13%, followed by pharmacology and cardiology, both at 8%, and oncology, the epidemiology of communicable human diseases, and immunology, all at 5%. Metabolism, gastroenterology, neurology, the epidemiology of non-communicable human diseases, and pulmonary medicine each account for 4%. Molecular biology accounts for 3.4% of the investigations.

According to MeSH qualifiers, the bibliographic portfolio consists of 17% methods, 16% diagnosis, 14% epidemiology, 12% statistics, 6% standards, 6% therapy, 5% drug therapy, 4.5% organization administration, 4% prevention and control, 3.5% adverse effects, 3% etiology, 2.5% complications, and 2% genetics, trends, classification, diagnostic imaging, psychology, pathology, and mortality. The MeSH headings attributed to the research papers included in the study are 61% about humans, 40% about electronic health records, 26% about algorithms, 23% concerning female human population, 20% males, 15% middle aged people, 13% adults, 11% retrospective studies, 10.5% machine learning, 7% natural language processing, 6% databases, and 5% risk factors.

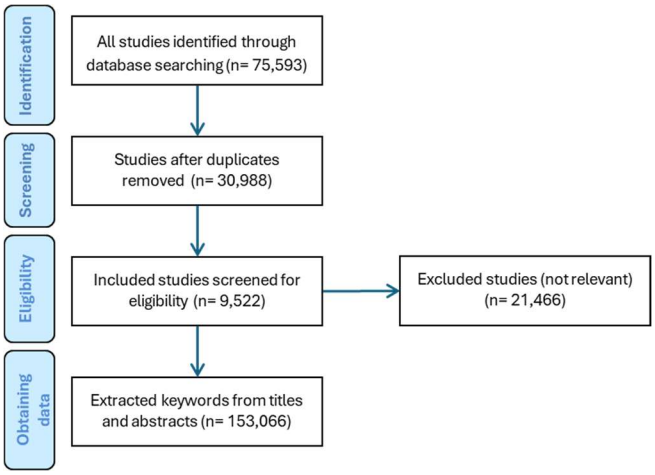

Fig. 1. *Literature review and keyword extraction study design. All documents were retrieved from PubMed, Web of Science Core Collection, and Scopus bibliographic databases.*

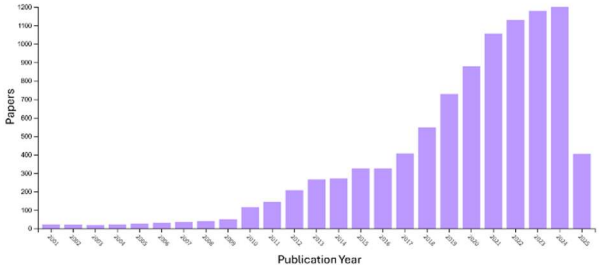

Fig. 2*. Publication years of the bibliographic portfolio.*

B. Computational technologies in healthcare

The bibliographic portfolio, which includes titles and abstracts, was imported into VOSviewer for further analysis. In total, 153,066 keywords were extracted that appeared at

least once in the corpus of included papers.

The VOSviewer analysis generated visualizations of keyword networks based on the number of occurrences, links, average publication year, and average citations. This data was extracted into visual illustrations in Portable Network Graphics (PNG) format and presented in tabular text files (TXT). The tabular text files were imported into spreadsheet software (Microsoft Excel®) for further analysis. These datasets were examined for specific questions regarding technologies, applications, or stakeholders.

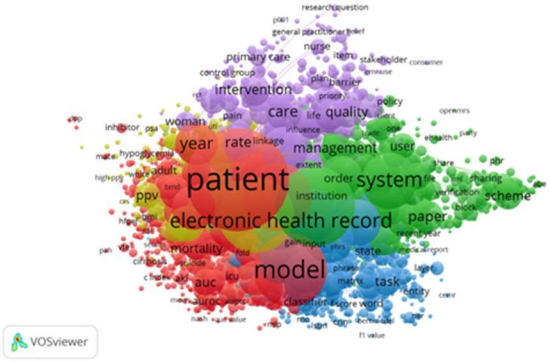

Fig. 3. *Network visualization of keywords with at least 20 times of co-occurrence in the bibliographic portfolio. A full count was considered, including multiple occurrences within a record. The term "patient" dominates in occurrences, followed by "electronic health record," "data," "algorithm," and "system."*

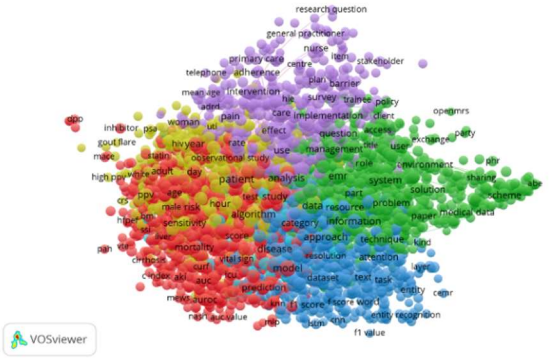

Fig. 4. *Network visualization of keywords with at least 20 times of co-occurrence in the bibliographic portfolio. A full count was considered, including multiple occurrences within a record. The size variation in occurrences for each circle has been reduced in $^{1}/_{10}$ to improve the resolution. There are six clusters of terms in red (cluster 1, 750 terms), green (cluster 2, 667 terms), blue (cluster 3, 509 terms), yellow (cluster 4, 404 terms), purple (cluster 5, 381 terms), and cyan (cluster 6, 63 terms).*

When examining the specific disruptive computational technologies utilized in healthcare and EMR management, the most interesting concepts, based on their frequency and relationships in the bibliographic portfolio, are:

- Machine Learning (ML) entails the analysis of patient data and medical images for various tasks, including disease diagnosis, risk stratification, medical image analysis, clinical decision support, optimization of clinical trials, modeling of longitudinal patient data, and administrative automation. It also tackles challenges such as data inconsistencies, incompleteness, irregular or temporal data, the risk of information leakage, bias, and feedback loops [13, 14].

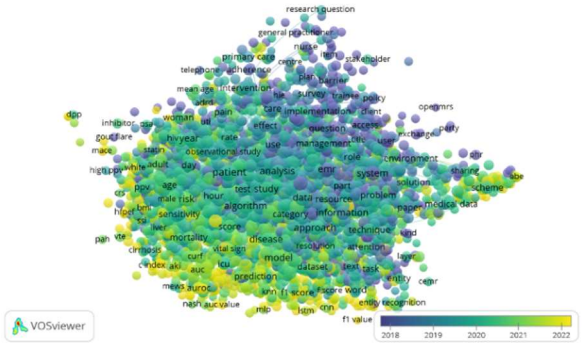

Fig. 5. *Network visualization of keywords with at least 20 times of co-occurrence in the bibliographic portfolio. A full count was considered, including multiple occurrences within a record. The terms are colored from dark blue to green and yellow according to the average year of publication of the papers to which they are referred. Cluster 5 appears in papers published on average in 2018, while the rest of the clusters appear in papers published on average between 2020 and 2024.*

Term	Occurrences	Average publication year	% of 9,522 docs
patient	1025121	2019.90	99.89%
model	511414	2020.82	99.32%
study	453277	2020.23	99.75%
risk	186439	2020.76	97.22%
year	216659	2020.12	96.76%
hospital	139681	2018.99	95.75%
outcome	149830	2020.40	97.04%
prediction	116289	2021.11	91.38%
machine	108678	2021.28	94.23%
treatment	115075	2019.81	96.11%
area	116703	2020.65	97.19%
score	115177	2020.41	92.68%
machine learning	94156	2021.70	94.27%
age	108563	2020.42	91.35%
cohort	93885	2020.73	89.51%
level	82931	2019.27	94.34%
day	91129	2019.92	88.07%
factor	81038	2019.93	91.28%
covid	79584	2022.25	73.22%
variable	75284	2020.54	88.57%

Table 3. The top 20 terms of cluster 1 concepts identified in the bibliographic portfolio, as determined by VOSviewer.

- Natural Language Processing (NLP) automates clinical documentation, extracts and structures clinical information, classifies and summarizes clinical notes, recognizes named entities (NER), detects clinical

conditions early, enhances research analytics, monitors activities of daily living (ADL), and addresses the risk of performance variability, which poses challenges for full integration into clinical workflows and leads to variability in performance [15, 16].

- Artificial Intelligence (AI) is used to analyze patient-generated health data (PGHD), provide clinical decision support, enhance personalized medicine, automate administrative tasks, identify errors, validate data, perform predictive analytics, and assist in drug development. However, there are drawbacks, including the variability of EMR entries, data volume, complexity of biological systems, challenges in making generalizations, and the potential for bias to be introduced during training [17, 18].

Term	Occurrences	Average publication year	% of 9,522 docs
data	602094	2019.74	99.96%
system	274442	2017.26	98.59%
electronic medical record	168663	2017.78	98.74%
time	175291	2019.41	98.49%
emr	146276	2017.72	94.95%
research	133969	2019.59	97.22%
application	108775	2019.37	95.71%
development	110968	2019.67	98.02%
paper	86259	2018.66	89.98%
process	100826	2019.14	93.73%
framework	93645	2020.22	89.73%
challenge	88669	2020.21	92.90%
technique	84693	2020.14	92.68%
network	75949	2020.00	90.45%
management	81082	2019.59	92.39%
review	75238	2019.99	89.62%
scheme	52820	2020.02	57.50%
technology	61551	2019.12	82.34%
problem	66476	2018.61	88.18%
need	70626	2019.36	92.50%

Table 4. The top 20 terms of cluster 2 concepts identified in the bibliographic portfolio, as determined by VOSviewer.

- Blockchain is utilized for storing encrypted EMRs in a decentralized ledger, allowing patients to manage their personal information via smart contracts. It facilitates transparent auditing of healthcare services, fraud prevention, and remote patient monitoring. However, there are caveats, including incompatibilities with personal data legislation in some countries, challenges in handling large volumes of healthcare data, and substantial implementation costs [19, 20].
- Clinical Decision Support Systems (CDSS) provide diagnostic assistance, optimize medication and treatment planning, offer real-time alerts for critical cases, deliver reminders, implement clinical guidelines, assist with patient triage in emergencies, monitor radiation doses, support nursing decisions, and enable mobile decision support. However, challenges include data incompleteness, physician alert fatigue, ethical concerns regarding accountability for failures, and algorithmic bias [21, 22].

Term	Occurrences	Average publication year	% of 9,522 docs
electronic health record	283813	2020.74	99.68%
ehr	272636	2020.73	99.13%
approach	219923	2019.79	98.92%
information	194449	2018.91	98.52%
performance	159915	2020.47	97.95%
disease	142497	2020.39	96.79%
accuracy	133963	2020.59	96.86%
dataset	119926	2020.94	94.63%
feature	115154	2020.53	94.84%
type	110079	2019.28	95.39%
evaluation	75611	2019.18	93.76%
task	68893	2019.74	82.19%
report	62488	2017.98	83.60%
natural language processing	63107	2020.45	87.13%
nlp	64857	2020.45	78.55%
detection	66445	2020.08	88.10%
term	59561	2019.36	90.84%
classification	56871	2020.22	85.72%
pattern	58168	2019.45	88.00%
rule	57003	2019.47	82.05%

Table 5. The top 20 terms associated with cluster 3 concepts, as identified in the bibliographic portfolio, according to VOSviewer.

Term	Occurrences	Average publication year	% of 9,522 docs
algorithm	515941	2020.26	99.75%
diagnosis	187050	2020.11	98.45%
case	169907	2019.39	97.33%
sensitivity	122838	2019.74	91.89%
database	113237	2018.67	96.18%
code	98379	2019.64	90.05%
specificity	94273	2019.72	89.62%
record	87165	2018.61	94.52%
population	99998	2019.91	92.39%
individual	83463	2020.69	90.41%
validation	72836	2020.31	93.08%
identification	69037	2019.83	92.83%
ppv	65143	2020.13	66.73%
medication	68972	2019.54	87.31%
condition	70634	2019.89	91.20%
icd	63808	2020.16	74.04%
visit	60999	2019.44	81.22%
positive predictive value	51622	2019.32	80.14%
child	46651	2020.31	68.67%
status	48983	2020.08	84.35%

Table 6. The top 20 terms associated with cluster 4 concepts, as identified in the bibliographic portfolio, according to VOSviewer.

- Support Vector Machines (SVMs) are supervised machine learning algorithms that use kernel functions to transform data into higher-dimensional spaces and classify it by calculating a hyperplane that maximizes the distance between each class. They are used in healthcare for similar purposes as ML, including early disease diagnosis, predicting disease progression, assessing prognostic risk, analyzing medical images, and classifying EMRs. However, there are caveats such as computational complexity, inconsistencies due to incomplete data, and preprocessing issues [23].

Term	Occurrences	Average publication year	% of 9,522 docs
use	204323	2018.50	99.17%
analysis	198563	2019.97	98.95%
tool	140252	2019.87	96.61%
care	146570	2019.00	94.27%
rate	103962	2019.67	93.04%
group	112738	2020.03	93.44%
intervention	126424	2019.56	89.37%
implementation	92173	2017.99	90.23%
value	104631	2019.78	94.02%
number	90961	2019.07	96.25%
quality	91097	2018.05	91.31%
clinician	79632	2019.12	89.91%
physician	76493	2017.23	88.39%
strategy	69260	2020.07	92.65%
impact	65232	2019.70	91.06%
month	86680	2019.34	82.05%
effect	70421	2018.68	88.21%
assessment	62990	2019.81	90.92%
measure	62544	2019.14	89.08%
participant	68911	2019.97	86.73%

Table 7. The top 20 terms of cluster 5 concepts identified in the bibliographic portfolio, as determined by VOSviewer.

Term	Occurrences	Average publication year	% of 9,522 docs
association	68833	2019.61	86.66%
control	58103	2019.55	85.47%
phenotype	47378	2020.34	70.19%
site	48934	2018.84	75.96%
bias	29177	2021.16	69.86%
interaction	27063	2018.71	70.33%
range	27918	2019.72	80.28%
variation	23108	2018.91	70.19%
variant	14408	2019.16	43.87%
electronic medical records	9869	2018.43	57.61%
gene	10381	2018.86	40.74%
trajectory	10619	2021.02	44.30%
variability	10346	2020.67	55.12%
biobank	8327	2019.45	37.56%
eye	6636	2020.44	26.32%
gain	6673	2018.27	44.45%
hypothesis	6811	2018.70	47.33%
meta analysis	7277	2021.09	39.62%
estimator	5112	2021.85	27.47%
simulation study	4905	2020.75	30.43%

Table 8. The top 20 terms of cluster 6 concepts identified in the bibliographic portfolio, as determined by VOSviewer.

- Extreme Gradient Boosting (XGBoost) is a machine learning algorithm used in EMR management for early diagnosis, imputation of missing data, predicting individual risk, defining personalized interventions, and managing large, structured datasets. It employs model-agnostic techniques such as permutation importance, which aligns with clinical intuition. However, it has limitations in interpretation, requires data preprocessing, and poses risks related to generalization and handling temporal data [24].
- Computational medical image analysis employs advanced algorithms that utilize deep learning frameworks, integrating convolutional neural networks (CNNs) and transformer architectures. This combination enables multimodal data fusion, along with the precise extraction and interpretation of anatomical, microscopic, and histological features for image segmentation and classification. This process distinguishes between physiological and pathological regions and categorizes images as normal or diseased, thereby aiding in diagnosis, treatment planning, and patient monitoring. These methodologies can enhance image quality and reconstruction by aligning and registering images from various time points or modalities, such as Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and Positron Emission Tomography (PET), all recorded in electronic medical records (EMRs). CNN-based models also apply to data from Internet of Medical Things (IoMT) devices, including wearable sensors and cellphone photography, to extract features of physiological or pathological signals during real-time health monitoring. The challenges these technologies face include the heterogeneity of imaging formats, population biases, and clinical mistrust, as they frequently function as “black boxes.” [25-27]
- Computational data encryption can secure healthcare data, personal information, and other sensitive content. This may involve: Data-at-Rest Encryption, which utilizes symmetric encryption algorithms like the Advanced Encryption Standard (AES) to ensure that EMRs remain confidential, even if storage media are compromised; Data-in-Transit Encryption, which secures the transmission of EMR data between healthcare stakeholders by employing specific secure protocols such as Transport Layer Security (TLS); Access Control Authentication, which encrypts credentials and session data to ensure that only authorized personnel can decrypt and access patient records; Secure Record Sharing, achieved through asymmetric encryption with public and private key cryptography, enabling the secure sharing of medical records between different healthcare entities; Transparent Data Encryption (TDE), which

encrypts entire databases or specific tables containing patient EMRs; and the Encryption of Portable Devices and Files, ensuring that patient data stored on portable devices or shared as PDF files containing prescriptions or bills is encrypted and password-protected to prevent unauthorized access; Audit and Integrity Verification with cryptographic hash functions like MD5 or SHA to verify the integrity of medical records and detect unauthorized modifications, ensuring data accuracy and trustworthiness. The challenges of encryption include managing multiple keys, interoperability issues, potential data loss due to the loss or corruption of encryption keys, and compliance with national legislation regarding data storage [28, 29].

- Recurrent Neural Networks (RNNs) effectively model sequential and temporal data, making them suitable for clinical event prediction, disease progression modeling, multilabel diagnosis, managing irregular and sparse data, and transferring health information across medical institutions. The challenge is to handle rare events, complications, or uncommon adverse effects [30, 31].
- Large Language Models (LLMs) can enable transformative applications in EMR management by leveraging NLP. LLMs accurately identify clinical entities through semantic textual similarity and inference. They improve understanding of clinical reasoning, support decision-making, and automate the summarization of clinical notes, patient histories, and EMRs. The main challenges include hallucinations and inaccuracies, bias and fairness issues, the interpretability of outputs, and ethical considerations [32, 33].
- Generative artificial intelligence (GenAI) automates clinical documentation, extracts information, and summarizes data while providing clinical decision support. It actively engages patients by offering educational materials and simplifying explanations of clinical conditions and therapies, thereby enhancing compliance and communication with healthcare providers. However, challenges and caveats include data privacy and security risks, potential inaccuracies, incorrect or fabricated information, biases, and computational and resource demands [34, 35].

Disruptive computational technologies collectively provide automation, enhance efficiency, enable high-throughput analysis, facilitate early detection and diagnosis, ensure administrative and audit control of healthcare services, enable patients to manage their personal data, gather health information, and promote rapid communication.

V. Discussion

Since the mid-1980s, the global implementation of computer-based management of Electronic Medical Records (EMRs) has facilitated unprecedented statistical and analytical processing of medical data to produce health information. The term "medical data" encompasses a wide range of qualitative entities, whether on a nominal or ordinal scale, as well as quantitative ones.

Unstructured medical data typically includes narrative descriptions and notes in text form, along with images, audio, or video files, entered directly into EMRs by clinicians, nurses, pharmacists, or bioscientists. Although it is stored in digital databases, it still constitutes blob data. Aside from the inherent complexity of biomedical data, the subjective descriptions of clinical examinations, symptoms, interviews, self-assessments, diagnoses, biopathological or histopathological findings, adverse events, and medical certificates, as well as the introduction of raw audiovisual content, pose significant challenges for systematic analysis.

In contrast to the freedom of expression and the description of unstructured medical data, modern electronic medical record (EMR) management systems provide a stricter framework for entries through predefined selection menus and options. Structured or discrete medical data attains specific values and acquires distinct meaning. The various database fields can be filled through standardized entry selections based on a controlled vocabulary of medical terminology, medical instruments, and measurement systems, utilizing numeric or alphanumeric fields organized into a data entry form that feeds into the EMR database. Dropdown menus assist users in entering structured data related to clinical diagnoses, procedures, medications, and tests across various registration fields. Typically, these systems restrict off-list data entry. If a healthcare stakeholder wishes to include something, such as a medication that is not on the existing list, the inclusion request must be submitted to the administrative authorities of the medical information system. Users of structured medical data systems gain access to:

- Planning medical services
- Organization and routing of clinical procedures
- Continuous access to data
- Document storage and retrieval
- Creation of patient guidelines
- Patient health records
- Management of clinical and laboratory tests
- Issuance of patient certificates and consent forms
- Information on adverse drug reactions
- Patient demographics
- Patient's medical history
- Medical prescriptions
- Guidelines for treating a disease
- Secure communication with medical service providers
- Insurance coverage verification
- Allergy lists
- Data archiving and destruction

- Data retention
- Drug interactions
- Guidelines and protocols
- Vaccination and immunization records
- Help with medical coding
- Standard medical care plans
- Medication lists
- Financial management and fees
- Communication with pharmacies
- Problem log lists
- Generate reports
- Exam referrals
- Good health and prevention criteria.

Structured medical data creates a highly functional computing environment that supports specialized analyses, interoperability, and compatibility with other systems while enhancing security and safety, as patient data is entered into a secure information environment accessible only to authorized users. Furthermore, because the EMR system design adheres to the principles of a knowledge information system, it aids in processing and interpreting collected data for decision-making, action design, and drawing conclusions.

EMR databases encompass repositories of health records, prescriptions, diagnostic tests, case and event reports, descriptions of clinical procedures, hospitalization data, disease certificates, vaccination certificates, scientific experiments, scientific publications, scientific papers, DNA sequencing results, RNA, proteins, structures, vertebrate genomic bases, metabolic and biochemical pathways, human and vertebrate genomes, human genes and diseases, microarrays and gene expression, proteomics, molecular biology, cell organelles, immunology, cell biology, anatomy, physiology, pathology resources, pharmacology, and clinical and pharmacological trials [36]. For many years, efforts have been made to address data heterogeneity and complexity in EMR databases by applying specific vocabulary rules in information exchange and communication. The interpretation of genetic associations, medical imaging, and the integration of medical device data recordings contribute to medical algorithms and professional assessments. However, to date, machine learning and artificial intelligence systems provide methodologies to apply predefined rules in pre-training, enabling advanced computing to curate or extract conclusions from medical data. Health information can be generated in a high-throughput manner by systematically processing medical data under the evaluation of a computer system.

This review centers on international literary perspectives, ideas, and practical applications of disruptive computer technologies in everyday medicine, with a specific emphasis on analyzing EMRs when necessary.

We found that most research papers on this topic are clinical or translational reports focusing on applying existing medical algorithms or developing new analytical ones for various pathologies affecting both sexes, particularly emphasizing middle-aged and elderly populations. Many of these papers utilize retrospective data from hospital EMRs or publicly available biomedical datasets to train machine learning systems, which are then used to analyze real-world clinical data in primary healthcare settings. These systems facilitate risk assessment, provide reproducible and accurate diagnosis, prognosis, and decision support for interventions aimed at preventing adverse effects, as well as tracking epidemiological trends.

All the applied methodologies agree on analyzing trends in computing technological advancements for medical record management over the past thirty years. iCite demonstrates the impact of these technologies in translational research, connecting the laboratory bench to the patient's bedside. Scopus keyword analysis and Web of Science MeSH and concept analyses, along with the VOSviewer map of keywords extracted from paper titles and abstracts, collectively highlight the significance of disruptive computing applications in pharmacology, cardiology, geriatrics, public health, and infectious diseases—where COVID-19 represents the top and most critical global health risk—oncology, and immunology, often in combination when immunological cell therapy is applied against tumors, as well as in neurosciences, pediatrics, pulmonology, genetics, general pathology, endocrinology, gastroenterology, hematology, surgery, urology, critical care medicine, obstetrics and gynecology, rheumatology, and ophthalmology. These applications can be utilized on-site at the premises of a hospital clinic, healthcare services center, or a doctor’s office, during patient administration, emergency or scheduled visits, or remotely through telemedicine or wearable medical device monitoring.

When considering the publication year of the studied papers, we can observe the timeframe of the innovations implemented or the concerns related to them. Informatics topics, such as the use of Extensible Markup Language (XML) in health information systems and electronic medical records, along with picture archiving and communication systems (PACS), the OpenMRS medical record system as open-source software for EMR management, and the application of Health Level Seven (HL7) medical standards in the exchange, integration, sharing, and retrieval of electronic health information, have been reported in papers published on average before 2013. Subsequently, schemes for semantic interoperability, Global Positioning System (GPS) integration, various EMR systems and their uses in adverse drug events (ADEs), as well as compliance with the Health Insurance Portability and Accountability Act to protect sensitive health information from disclosure without patient consent, which was introduced as a federal standard in 1996, were reported in papers with an average publication year of 2015. Topics such as Informatics for Integrating Biology and the Bedside (i2b2) and eHealth, as a generic description of EMRs, electronic prescribing, telehealth, decision support, single nucleotide polymorphisms (SNPs) for genetic association studies, the application of SNOMED Clinical Terms standards, and the Telecare Medical

Information System (TMIS) in health monitoring and medical services over internet or mobile networks at any place and any time, Structured Query Language (SQL) for retrieving stored data and extracting information from Relational Database Management Systems (RDBMS), automatic algorithm implementation, and Phenome-Wide Association Studies (PheWAS), as an inverted Genome-Wide Association Study (GWAS), are discussed in papers with an average publication year of 2018. Machine learning approaches, medical Big Data, Randomized Control Trials (RCTs), classification systems for Potentially Preventable Emergency Department Visits (PPVs) as innovative patient clinical management to avoid complications in outpatient and ambulatory settings, early warning systems, Fast Healthcare Interoperability Resources (FHIR)-based electronic health records, propensity score matching for comparative studies, regression analysis and models, positive and negative predictive values (PPV and NPV, respectively), crucial tools for diagnostic accuracy, patient demographics, elliptic curve cryptography in EMRs, computable phenotype algorithms, Convolutional Neural Networks (CNN) using deep learning approaches in healthcare systems, and Natural Language Processing (NLP) tools in clinical practice are found in papers published on average in 2020. Discussions in papers published on average in 2022 include Artificial Intelligence algorithms (AI algorithms), Artificial Neural Networks (ANN), Support Vector Machines (SVM), applications of the area under the receiver operating characteristic curve (AUC-ROC) to assess AI model performance, F1-score evaluation of machine learning, applications of the Medical Information Mart for Intensive Care (MIMIC-III) critical care database in AI systems, nomograms, precision-recall (PR) curves for simulation prediction models, Extreme Gradient Boosting (XGBoost) models, NLP models, the Internet of Medical Things and Healthcare (IoMT), Protected Health Information (PHI), and clinical concept extraction using transformers such as BERT, RoBERTa, BERTTweet, TwitterBERT, BioClinical_Bert, BioBert, ALBERT, and ELECTRA, along with pretraining strategies like domain-adaptive pretraining (DAPT), source-adaptive pretraining (SAPT), or topic-specific pretraining (TSPT). Finally, papers issued on average in 2024 discuss Large Language Models (LLMs), SHapley Additive exPlanations (SHAP) analysis integrated into machine learning models to address the challenges of black-box predictions or classifications, Generative Pre-trained Transformers (GPT), and ChatGPT.

This study was conducted using three bibliographic and bibliometric databases: NCBI PubMed, Elsevier Scopus, and Clarivate Web of Science. Gray literature or preprints were not included, which represents a limitation. In computer science, preprint server repositories, such as Cornell University arXiv (arxiv.org), are often used to present machine learning or artificial intelligence models, methodologies, and applications. Nonetheless, when these systems interrogate applied clinical data, the results are published in biomedical journals. Therefore, it is expected that the record of published scientific publications aligns well with trends in computational applications for EMR management.

VI. Conclusions

The introduction of innovative computational technologies and automated analytical frameworks in biomedical research and routine clinical practice marks a transformative breakthrough in EMR management. This text summarizes these technologies and their applications, along with their implementation timelines. Machine Learning (ML), Natural Language Processing (NLP), blockchain, Clinical Decision Support Systems (CDSS), Support Vector Machines (SVMs), computational data encryption, Large Language Models (LLMs), and Generative Artificial Intelligence (GenAI) systems are examined in the context of EMR management. These disruptive computational technologies, both individually and collectively, enhance the extraction of health information from medical data and the generation of new biomedical knowledge.

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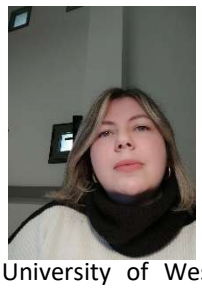
VIII. AUTHORS



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Journal of Integrated Information & Management

Volume 10 - Number 1 / Jan - Jun 2025
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