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Empowering the management and performance accounting system in healthcare organisations with Artificial Intelligence: Literature and industry cases

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ABSTRACT

We explore the transformative impact of Artificial Intelligence on the healthcare organisations through a mixed-methods approach that involves a critical analysis of both literature and industry trends (based on real-world practices and illustrative cases), as rapidly emerged in recent years. Specifically, we focus on the powerful yet partially underexplored intersection of AI in health management and accounting systems. As technological advancements reshape the healthcare landscape, we found AI to be a pivotal tool in managing, innovating, and optimising strategic and operational processes, thereby enhancing executive decision-making. The main outcome of such a process – facilitated by an effective collaboration between managers and experts (data scientists and IT professionals) – is the improvement of both patient care and financial efficiency in order to create overall value. This is achieved through more in-depth real-time monitoring of key performance indicators (KPIs) such as patient outcomes, resource utilisation, and financial metrics. We also critically review new challenges including data privacy, security, and ethical considerations, highlighting the importance of responsible AI deployment to build patient trust and ensure regulatory compliance. Additionally, raising public awareness of AI and establishing standardised guidelines are necessary steps. By investigating novel applications of AI in healthcare administration, financial management, and the synergies between these areas, the article can benefit a diverse audience across various domains, including healthcare, technology, public administration, and academia. Limitations and future research directions are also outlined.

Per mezzo di un approccio metodologico misto, fondato su un'analisi critica sia della letteratura che delle tendenze del settore (pratiche e casi illustrativi reali), come emerso rapidamente negli ultimi anni, il lavoro indaga l'impatto trasformativo dell'Intelligenza Artificiale sul settore sanitario, in particolare sull'intersezione - ancora parzialmente esplorata dalla dottrina scientifica esistente - tra gestione sanitaria e sistema contabile. Man mano che i progressi tecnologici continuano a ridefinire dinamicamente il panorama sanitario, si appalesa un'espansione dell'IA come strumento nuovo e potente per la gestione, l'innovazione e l'ottimizzazione dei processi strategici e operativi (migliorando il processo decisionale della sfera direzionale). Si

rileva come effetto principale di tale processo - in quanto derivato da una fruttuosa integrazione di manager ed esperti (data scientists / professionisti IT) - un miglioramento sia delle cure per i pazienti che dell'efficienza finanziaria (cioè, del sistema di fornitura/erogazione complessiva di servizi sanitari al fine di generare valore aziendale) grazie a un monitoraggio in tempo reale più profondo dei KPIs (outcomes dei pazienti, utilizzo delle risorse e metriche finanziarie). Emergono altresì le nuove sfide come la privacy dei dati, la sicurezza e le considerazioni etiche, sottolineando l'importanza di un impiego responsabile dell'IA per assicurare la fiducia dei pazienti e la compliance normativa. Appare necessaria una consapevolezza pubblica dell'IA e l'istituzione di linee guida ad hoc standardizzate. Esplorando le nuove applicazioni dell'IA nell'amministrazione sanitaria, nella gestione finanziaria e nelle sinergie tra esse, questo lavoro è indirizzato ad un pubblico diversificato interessato ai vari settori dell'industria sanitaria, della tecnologia, dell'amministrazione pubblica e del mondo accademico.

Keywords: Artificial Intelligence, Health Management and Accounting System, Healthcare Data Analytics, Patient-centric

1 – Introduction

While the relentless march of technological progress permeates every facet of our lives, the specific field of healthcare stands prominently at the intersection of this new leap (shift towards Healthcare 5.0). In particular, the adoption of Artificial Intelligence (AI) in the healthcare sector (medical services, equipment or drugs, insurance, etc.) and its integration into the health management and accounting system heralds a new era, one where advanced algorithms and machine learning systems converge with the intricate complexities of patient care, administrative tasks, and financial management itself.

Characterised by dynamic and intricate nature, healthcare industry has been grappling with the need for innovative solutions to enhance operational efficiency, patient outcomes, and financial sustainability. In response to these challenges, AI is emerging as a catalyst factor, presenting unprecedented opportunities to revolutionise the way healthcare is managed and accounted for.

Historically, the healthcare sector has been burdened by intricate administrative processes, resource allocation challenges, and the priority to deliver optimal patient care. The advent of AI offers a promise to alleviate burdens and to usher in a new age of streamlined operations, data-driven decision-making, and improved patient-centric services.

That said, this research – based on a critical analysis of literature and new practices – endeavors to comprehensively explore and elucidate the multifaceted impact of AI on health management and accounting. Overarching objectives: investigating the applications of AI in patient care, administrative tasks, and financial management within the healthcare domain; examining the interplay between health management and accounting, emphasising the synergies facilitated by AI; assessing the implications of AI on operational efficiency, patient outcomes, and financial sustainability in healthcare organisations. The scope is to provide new elements for a holistic awareness of the transformative potential within the healthcare sector.

The research may assume a certain significance in the context of a highly evolving healthcare landscape. In fact, as AI technologies become increasingly sophisticated, the need to comprehend their impact on health governance becomes imperative. Insights from such examination aim to orient healthcare professionals (medical, IT, consultants or practitioners), policymakers, academics and technologists in crossing the complexities of AI adoption,

ultimately contributing to the provision of better and innovative healthcare services as well as the related management strategies, i.e., unveiling a new pathway – for healthcare leaders, managers, administrators, operators – to more efficient, adaptive, and patient-centered healthcare governance. Hence,

> RQ: *How can the growing adoption of Artificial Intelligence (AI) contribute to integrate and enhance health management and accounting / performance system in competitive healthcare organisations?*

To comprehensively investigate the impact of AI's functional integration in health management and accounting, we employ a mixed-methods approach, based on a critical analysis of scientific literature findings and – in tandem – best emerging industry trends (by reviewing real-world practices drawn from selected relevant healthcare cases).

Subsequent sections unfold as follows: *Section 2* provides the literature review, drawing the state of the art and possible evolution of AI in health management and accounting. *Sections 3*, compliant to the methodological development, explores the technical applications of AI in new health management and accounting, respectively, reviewing illustrative exemplifications and practices. *Section 4* outlines the integration of AI in both domains, uncovering synergies and opportunities, while *Section 5* reports relevant practices / examples (providing the industry point of view). Challenges (alongside barriers and risks), ethical considerations, and future trends are included in *Section 6*, leading to the conclusion in *Section 7* (embracing limitations and future directions). Being in some respect propaedeutic, this work is open to further development. References are placed in the last Section.

2 – Literature review: scientific background

The recent integration of AI in health governance is garnering considerable attention within academic and industry literature. This section reviews key studies, frameworks, and models that are shaping its potential in transforming healthcare administration and financial management. Indeed, the use of AI in healthcare management and accounting is a growing area of interest (Cho, 2024).

Early explorations into the integration of AI in healthcare set the foundation for subsequent developments. Studies such as those by Topol (2019) and Jiang *et al*. (2017) investigate the evolution of AI technologies, examining their progression from experimental phases to becoming integral components in diagnostic processes, treatment planning, and personalised medicine. He at al. (2019) and Rajpurkar *et al*. (2022), in turn, provide an overview of practical implementation of artificial intelligence technologies specifically in medicine.

Bohr & Memarzadeh (2018) and Azzi *et al*. (2020) contribute valuable insights into the diverse applications of AI in health management. They highlight the impact of AI on patient care, administrative tasks, and data analytics, emphasising improvements in operational efficiency and patient outcomes through case studies and empirical evidence.

Through a combined systematic review and Machine-Learning approach, Santamato *et al*. (2024) explore how AI influences healthcare management in operational, strategic, and emergency response domains, and identify variations in the impact of AI on healthcare management based on temporal and geographical contexts.

As for healthcare accounting, research has explored the transformative potential of AI in financial processes. While Oppi *et al*. (2019) already pointed out clinicians' resistance to

accounting as the consequence of the inadequacy of the information systems, Sahni *et al*. (2023) discussed the automation of financial tasks, emphasising its impact on reducing costs and errors, streamlining administrative burdens. Secinaro *et al.* (2021a), instead, examined through a twenty-year bibliometric analysis, the important role of Data quality for health sector innovation and accounting management, arguing that a structured data quality process helps value healthcare data adequately and reduces costs (moreover, quality is fundamental before applying advanced data analytics through big data analytics, IoT and AI applications). Additionally, the predictive analytics capabilities of AI in financial decision-making are deemed powerful in optimising budgets and resource allocation. In particular, great benefits can be generated in the field of management accounting (O'Leary, 1995; Massaro *et al*., 2016). In terms of operating management and business information, Mehta & Devarakonda (2018) and Rajkomar *et al*. (2019), instead, described machine learning, natural language programming, neural networks, and electronic health records as new basis for the usage of artificial intelligence journey producing intelligent data.

More in general – through a thorough structured review –, Secinaro *et al.* (2021b) reveal that United States, China, and the United Kingdom contribute the highest number of (often interdisciplinary) studies focused on health services management, predictive medicine, patient data and diagnostics, and clinical decision-making. Their study reveals that AI can support physicians in making a diagnosis, predicting the spread of diseases and customising treatment paths. In addition, specific studies on AI in accounting and auditing profession (which started a sort of metamorphosis stage) have been conducted by Omoteso (2012), Bizarro & Dorian (2017), and Hasan (2021). An interesting analysis of the impact of AI application on the development of accounting industry was carried out by Luo *et al*. (2018): as per their investigation, certain issues related to the utilisation of AI in the accounting sector involve (along with potential benefits as improved productivity, efficiency, customer services, risk management, manpower saving / reallocation, workforce flexibility, etc.) an initial lack of expertise, a relatively slow return on a significant investment, and a shortage of necessary skills and qualities among professionals. In companies' administration, further problems can be the lack of motivation and commitment to IA from the organisational leadership, as well as the initial resistance from existing workforce (Mohammad *et al*., 2020).

Definitely, the literature discloses several AI applications for health services and, at the same time, a stream of research that has not fully been covered yet. For example, AI projects require skills and data quality awareness for data-intensive analysis and knowledge-based management. The topic of technological, regulatory and societal barriers to a more intensive use of AI (opacity, biases, trust, privacy, accountability issues, etc.) also requires a supplement of investigation.

Morley *et al*. (2020) and Schönberger (2019), in turn, contribute by addressing interdisciplinary challenges and ethical considerations associated with the integration of AI in healthcare. These studies delve into issues of data privacy, security, and the ethical implications of AI, stressing the importance of a responsible deployment to maintain patient trust and uphold regulatory standards. In this vein, recently, Wang *et al*. (2023) addressed ethical considerations of using ChatGPT (or similar tools) in healthcare, which really represents a very new frontier to cope with.

Ongoing research and emerging trends are explored by Dash *et al*. (2019) and Wang *et al*. (2019), developing preliminary research conducted by Murdoch & Detsky (2013). These studies

provide insights into the future implications of AI in health management accounting, discussing potential advancements, challenges, and the need for collaborative efforts to harness the full benefits of AI in optimising healthcare operations and financial management. In particular, they focus on the application of big data management in health sector (e.g., by using analytics to identify and manage high-risk and high-cost patients). The modern health industry, in fact, is taking vigorous steps to convert big data and digitalisation potential (ultimately including Internet of Things technology and telehealth) into better services and financial advantages, with a strong integration of biomedical and healthcare data: this way, the healthcare organisations have the opportunity to revolutionise the biomedical research and therapies (including precision medicine and remote patient monitoring). Finally, in line with Mamoshina *et al*. (2018), Kumar *et al*. (2023) integrate AI and blockchain with interesting evidence, grating the secure storage of patient data.

In summation, the literature review underscores the dynamic nature of AI in health management and data accounting, highlighting the evolution, applications, challenges / risks, which allow to outline some impactful future prospects. As the field continues to evolve, the synthesis of knowledge from these diverse studies serves as a foundation for understanding the multifaceted impact of AI on reshaping the healthcare landscape.

3 – AI in healthcare sector's administration: state of the art and prospects

Across the globe, several relevant healthcare organisations have been incorporating AI into their activities to varying extents. We analysed (basically through technical information reported on their websites, investor relations pages and annual reports / disclosure – alongside initiatives communication, announcements, scientific publications, professional reports, and interviews) the following (major) healthcare organisations as long as have shown significant interest and experimentation (when 'user'), or expertise (when 'provider' or have been involved) in AI technology and/or administrative solutions. Summing up, in line with Park *et al*. (2020) and Gupta & Kumar (2023), primary production applications – in most cases technologically disruptive and radical, even if under a limited focus strategy – concern Medicine, Medical device, Health IT and Diagnostic image, basically employing the following technology: Robotics, Digital secretary, Machine learning, Image processing, Natural language and Voice recognition, Statistical and Big data analysis, Predictive modeling, and further technological advancements (Table 1).

Table 1 – Literature findings and major evidence from cases

Healthcare Organisation	AI's Operating Description	Source/Literature
Mayo Clinic (USA)	Has been exploring AI applications in various areas, including diagnostics, personalised medicine, and patient care.	Wen *et al*., 2019
Cleveland Clinic (USA)	Known for its innovative approach to healthcare, involved in AI research and implementation for improving patient outcomes, including initiatives like the Machine Learning Arthroplasty Laboratory.	Helm *et al*., 2020

Healthcare Organisation	AI's Operating Description	Source/Literature
NHS - National Health Service (UK)	Has been exploring AI applications for improving patient care, operational efficiency, and public health initiatives.	Bloomfield *et al*., 2021
SGH - Singapore General Hospital (Singapore)	Engaged in AI research and implementation for enhancing patient care, diagnostics, and hospital operations.	Hock, 2021
Karolinska University Hospital (Sweden)	Involved in AI research and implementation, particularly in medical imaging, diagnostics, and precision medicine.	Liu *et al*., 2024
SMC - Samsung Medical Center (South Korea)	Major hospital and medical facility utilising AI in medical imaging and diagnostic purposes.	HIMSS, 2023
AP-HP - Assistance Publique - Hôpitaux de Paris (France)	One of the largest hospital systems in Europe, focused on integrating AI in diagnostics and treatment processes, including pathology and radiology.	Daniel & Salamanca, 2020
Charité – Universitätsmedizin, Berlin (Germany)	Actively involved in AI research and implementation, especially in medical imaging, data analytics for decision support systems, and dentistry.	Mertens *et al*., 2021
AIIMS (India)	Engaged in AI research and applications in areas like diagnostics, telemedicine, and healthcare analytics.	Gupta & Gupta, 2024
Sheba Medical Center (Israel)	Exploring AI applications in medical fields, including radiology, pathology, and personalised medicine.	Zloto *et al*., 2024
Moorfields Eye Hospital (UK)	Collaborated with DeepMind for AI research, particularly in retinal scan analysis for early detection of eye diseases.	Williamson *et al*., 2024
Radboud University Medical Center (Netherlands)	Utilises AI for medical imaging analysis, pathology, and patient data analytics.	Huisman & Hannink, 2023
Bambino Gesù (Italy)	Major pediatric hospital in Rome, exploring AI in pediatric healthcare for improved diagnostics and treatment.	Andellini *et al*., 2023
PH - Philips Healthcare (Netherlands)	Incorporating AI into healthcare technology, focusing on patient monitoring, diagnostics, and treatment enhancement.	Ramanathan & Jagadeesha, 2022
GE Healthcare (USA)	Leading healthcare subsidiary of General Electric, integrating AI into medical imaging, diagnostics,	Stephens, 2021a

Healthcare Organisation	AI's Operating Description	Source/Literature
	and healthcare analytics to enhance diagnostic accuracy and workflow efficiency.	
IBM Watson Health (USA)	IBM's pioneering division collaborates with healthcare organisations, researchers, and industry partners to advance healthcare with AI for data analytics, diagnostics, and treatment recommendations.	Jiang *et al*., 2017
M*Modal (USA)	A healthcare technology company, subsidiary of 3M, providing AI-powered clinical documentation and speech recognition solutions.	Stephens, 2021b
SH - Siemens Healthineers (Germany)	Siemens Group's healthcare division utilises AI across medical imaging, laboratory diagnostics, and healthcare management solutions.	van Giffen & Ludwig, 2023
AstraZeneca (UK)	Actively pursuing AI applications in drug discovery and development through collaborations and investments with AI startups and research institutions.	Shields *et al*., 2024
Pfizer (USA)	Leveraging AI for drug discovery, particularly in target identification and validation.	Qi & Lei, 2022
Novartis (Switzerland)	Actively exploring AI for drug discovery and development, focusing on machine learning for biological data analysis and personalised medicine.	Siah *et al*., 2021

Considering both literature findings and major evidence from cases, the integration of AI in health management aspects (hard and soft, alongside the operating / productive function) began to mark an utter paradigm shift in the healthcare scenery, presenting multifaceted benefits across – we can summarise – patient care (a), administrative tasks (b), and digital administration enhancing both patient satisfaction and operational productivity (c).

(a) AI's impact on patient care appears in most cases significantly profound, revolutionising diagnostics, treatment plans, and personalised medicine (Johnson *et al*., 2021). Essentially, this is due to Machine learning algorithms which, trained on vast datasets, denote a higher accuracy in detecting diseases at early stages, aiding clinicians in more timely interventions. Additionally, AI-driven predictive analytics assists healthcare providers in identifying patients at risk for specific conditions, enabling proactive and preventive care strategies. Most case studies reviewed, especially those involving AI-powered diagnostic tools and virtual health assistants, underscore the transformative potential of AI in improving patient outcomes and fostering a patient-centric healthcare approach.

(b) The administrative burden in any healthcare organisation is notorious for its complexity and resource-intensive nature. It is estimated that in US doctors spend an average of 15.5 hours per week on paperwork and other administrative tasks, ranging from 9 hours for anesthesiology to 19 hours for rehabilitation (see Medscape's 'Physician Compensation Report' for 2023; In Italy,

numbers are even worse, with 23 out of 40 hours dedicated to bureaucracy: doctors and nurses - often hit by high rates of stress burnout - spend a large part of their time on data entry, managing electronic systems and administrative tasks in general, i.e. 'non-clinical' activities, such as compiling documents, managing medical records and organisational activities). AI began to streamline administration tasks by automating routine processes, such as appointment scheduling, billing, and insurance claim processing. Natural Language Processing (NLP) algorithms came to enable efficient management of electronic health records (EHRs) by facilitating seamless communication and information retrieval for healthcare professionals. From the best cases reviewed, AI-driven administrative solutions not only reduce the workload on healthcare staff but also minimise errors, ensuring accuracy in financial transactions and regulatory compliance commitment.

(c) In the big data era, AI opportunity in digital management is a cornerstone for an effective health administration. It enables the extraction of valuable insights from vast datasets, aiding in evidence-based decision-making. The predictive modeling powered by AI proved capable of assisting managers in forecasting patient admission rates, resource allocation, and optimising inventory levels. Moreover, telemedicine, remote patient monitoring and real-time monitoring of health metrics through wearable devices and IoT (Internet of Things), where applied, can contribute to a more comprehensive understanding of patient health trends. In particular, healthcare organisations' practices elucidate how AI-driven data analytics is enhancing the agility of business even fostering proactive responses to emerging challenges.

As a consequence, the fusion of AI applications in patient care and administrative tasks would translate into tangible improvements of operational efficiency and user outcomes. In turn, streamlined processes are able to lead to cost savings, reduced administrative errors, and enhanced resource utilisation. Concurrently, precision and timeliness achievable in clinical care management through AI contribute to improved diagnoses, personalised treatment plans, and overall better healthcare experiences (Alowais *et al*., 2023). These combined effects underscore the potential of AI to elevate *coeteris paribus* the efficiency and effectiveness of health management systems with lower risk. In this regard, a successful implementation of the above-mentioned technologies can hinge on addressing challenges related to interoperability and data privacy, helping AI applications align with ethical standards. Furthermore, ongoing research and collaboration between healthcare professionals, technologists, and policymakers will be crucial to harnessing the full potential of AI in reshaping the future of healthcare delivery and management.

Similarly, we draw that AI in healthcare accounting is rapidly supporting and transforming financial management of healthcare organisations, determining an automation of financial processes (d). In fact, it reshapes traditional practices, prospecting unprecedented efficiency, accuracy, and strategic insights by means of predictive financial analytics (e). As the healthcare sector contends with complex financing and increasing demands for data and information transparency, AI emerges as a critical tool in addressing these challenges by involving fraud and risk analysis (f). Definitely, AI provides a more effective analysis of economic efficiency thanks to cost optimisation and revenue cycle management (g).

(d) We learn that AI-driven automation plays a pivotal role in healthcare accounting, rationalising labor-intensive (where redundant and time consuming) financial processes. From invoicing and billing to payroll management, AI systems equipped with machine learning

algorithms handle routine tasks with precision. This not only accelerates (as stated earlier) the speed of financial transactions but also reduces the likelihood of errors, ensuring compliance with regulatory standards and mitigating financial risks. The best instances illuminate how AI-powered automation in healthcare accounting can significantly minimise administrative costs, allowing financial teams and staff to focus on more strategic initiatives. In more economic terms, such rationalisation of activities leads to reduced costs and increased resource productivity and returns.

(e) In cases where integration of AI in healthcare accounting extends beyond routine tasks, often it delves into accurate predictive financial analytics. Machine learning algorithms allow proactive health managers to analyse historical financial data to identify patterns, forecast trends, and predict potential financial challenges. In fact, such a compounded capability shows to aid healthcare organisations in proactively administrating budgets, optimising resource allocation, and developing strategic financial plans. The reviewed examples let us observe how AI empowers financial decision-makers with actionable insights, enabling them to sketch the ever-changing financial terrain of the industry with strategic planning and adaptability. AI leads to a more profound and effective real-time KPIs monitoring generally classifiable – referring to medical and hospital facilities – as follows: Patient outcomes (mortality rate, patient satisfaction scores, readmission rates, average length of stay, complication rates); Resource utilisation (bed occupancy rate, emergency department throughput, operating room utilisation, appointment wait times, staffing ratios); Financial metrics (revenue growth, operating margin, cost per patient, accounts receivable days, return on investment).

(f) Furthermore, healthcare accounting system starts to cope with inherent challenges related to fraud and financial mismanagement, although still timidly. AI algorithms potentially leveraging anomaly detection and pattern recognition are increasingly required to detect irregularities and mitigating financial risks. By continuously processing financial transactions and patterns, the information system is able to identify discrepancies that might indicate fraudulent activities or financial irregularities. Notably, the illustrative cases have in some cases pointed out the effectiveness of AI in enhancing the security and integrity of financial systems, safeguarding the healthcare organisations against potential financial losses (more likely where an appropriate risk management system is in place).

(g) In more detail, AI best practices end up contributing significantly to cost optimisation and revenue cycle management in healthcare accounting. By processing vast datasets, AI algorithms ensure the ability to identify in real-time areas for cost reduction, optimise pricing strategies, and enhance revenue generation. By automating the revenue cycle, from patient billing to claims processing, AI lets healthcare governance catch the opportunity to accelerate cash flow, reduce billing errors, and ensure timely reimbursements. In best cases, AI-driven approaches in cost optimisation and revenue cycle management eventually lead to greater financial sustainability and economic efficiency for healthcare institutions.

4 – Integration of AI in healthcare management and accounting system: unlocking synergies to drive performance

On the basis of the above-mentioned illustrative cases, it emerged that the integration of AI in health management and accounting system (as long as effective) can drive operational synergies ending to optimise (a) resource allocation and (b) budgeting and financial forecasting,

simultaneously improving (c) patient care through financial insights, finally facilitating (d) overall organisational efficiency.

(a) AI's prowess in data analytics is able to empower healthcare organisations to make more informed decisions regarding (AI-driven) resource allocation. By analysing massive datasets encompassing patient demographics, treatment outcomes, and operational processes, AI models can identify patterns and trends that elude traditional methods. This granular understanding allows for optimised distribution of staff, equipment, and facilities, ensuring that healthcare resources are deployed precisely where and when they are needed most. Best case studies within this realm showcase instances where AI-driven resource allocation has got the potential to lead to cost savings, reduced wait times, and improved patient satisfaction. Obviously, this achievement requires a proper use of the software.

(b) Effective budgeting and financial forecasting are critical components of sustainable healthcare management. AI's predictive analytics capabilities enable organisations to anticipate financial trends, identify potential risks, and align budgets with evolving needs. Machine learning algorithms (MLA) process historical financial data taking into account various influencing factors to provide accurate forecasts. The most innovative practices point out how AI facilitates precision budgeting, allowing healthcare administrators to proactively address financial challenges, allocate funds strategically, and achieve fiscal stability as well. Other activities to be mentioned: analysis of profit centers, overhead, opportunity and hidden (figurative) costs, investments valuation, capital budgeting, cash flows (IRR, NPV, payback periods), capital expenditures and cost of capital monitoring, variance / sensitivity and scenario simulation, budgetary control and financial performance measuring (value creation perspective).

(c) The integration of AI in health management and accounting system is prone to extend far beyond operational efficiency. Financial insights deriving from AI models can inform healthcare professionals about the economic implications of different treatment modalities enabling a more nuanced approach to care delivery. As the healthcare firms navigate the delicate balance between financial sustainability and patient-centric services, AI appears ready to serve as a guiding support, ensuring that financial considerations align with the overarching goal of improving patient outcomes. AI-driven financial insights (occupancy rate, patient mix and payer mix, cost per patient day, etc.) through specific software will contribute to optimisation of treatment plans, resource utilisation, activity-based and patient-level costing, competitive benchmarking and patient experience (resource-based analysis and competitive advantage perspective).

(d) A correct symbiosis of AI, health management, and accounting task results in streamlined processes. Automated workflows would reduce administrative burdens, minimise errors in financial transactions, and enhance overall efficiency. By seamlessly integrating financial data with health management systems, organisations will achieve a more holistic view of their operations.

Against this modern backdrop, pioneer software like (e.g.) Tableau, Power BI, QlikView/Sense, SAP BusinessObjects, SAS BI, Looker, or Zoho, for example, represent powerful business intelligence and smart data visualisation tools which have recently emerged as a game-changer for a growing number of organisations, helping them make data-driven

decisions and streamline their workflow by analysing operational metrics. Instances offering industry tailored solutions adopted by healthcare firms include, among the others (see *infra*), Sisense for Healthcare Analytics, Epicor Health, Cerner PowerChart, and IBM Cognos Analytics. Healthcare organisations leverage such solutions for a range of applications, including performance monitoring and reporting (with key performance metrics such as patient satisfaction scores, hospital readmission rates, and staff productivity). Real-time insights facilitate quick decision-making and proactive management of healthcare services. Moreover, business intelligence can support healthcare firms in financial planning, budgeting, and cost analysis (by integrating financial data and metrics from different departments, organisations are aided to gain a comprehensive understanding of their financial health, identify areas for cost optimisation, and make data-driven financial decisions).

5 – AI in healthcare management and accounting system: illustrative examples

More specifically, we feel to include the following relevant examples of AI software (or AI-based healthcare companies) for the examined healthcare organisations (random listed in Table 2).

Table 2 – Relevant examples of AI software for the examined healthcare organisations

Application (AI-based company)	AI Specialisation / Domain
IBM Watson Health	Offers AI-powered solutions for clinical decision support, data analytics, and personalised medicine.
Cerner	Utilises AI in electronic health records (EHRs), population health management, and clinical decision support.
Epic Systems	Integrates AI in EHRs and healthcare management systems to enhance clinical workflows and patient care; EpicCare sub-software employs AI for patient data management, clinical documentation, risk assessment through predictive analytics, and scheduling support with virtual assistants.
Philips HealthSuite	Provides AI solutions for medical imaging, patient monitoring, and population health management.
Siemens Healthineers - AI-Rad Companion	Focuses on AI applications in radiology for automated image analysis and interpretation.
Tempus	Specialises in AI and machine learning for analysing clinical and molecular data to improve cancer care.
PathAI	Focuses on AI-powered pathology solutions, aiding pathologists in diagnostic decision-making.
Zebra Medical Vision	Offers AI algorithms for medical imaging analysis, assisting in early detection and diagnosis.
Arterys	Specialises in AI applications for medical imaging, including cardiovascular and oncological imaging.

Application (AI-based company)	AI Specialisation / Domain
Insilico Medicine / Chemistry42	Known for AI applications in drug discovery and healthcare.
Aidoc	Focuses on AI solutions for radiology, providing tools for the detection and prioritisation of critical conditions in medical imaging scans, including CT scans.
Butterfly Network	Combines AI with handheld ultrasound devices, allowing for portable and cost-effective imaging solutions.
Nuance Communications	Offers AI-driven speech recognition and natural language processing solutions, including Dragon Medical for enhancing clinical documentation and workflow efficiency.
Google Health	Involved in various healthcare AI initiatives, including projects related to medical imaging and diagnostics.
Vertex AI	Used for robust data management and search capabilities, assisting healthcare professionals in searching vast databases for patient records and clinical trial information.
Microsoft-Azure Health Bot	Cloud-based service designed to enhance healthcare delivery by providing intelligent, conversational support, aiming to improve patient engagement and healthcare service efficiency.
MedicoReach	Healthcare-focused platform leveraging data analytics and digital marketing to enhance patient engagement and optimise healthcare communications, bridging gaps between healthcare providers and patients.
Zepp Health	Specialises in wearable technology, particularly fitness trackers and smartwatches for monitoring health and fitness metrics.
Recursion pharmaceuticals	Drug discovery and development.
AugMedix	Medical data mining.
CloudMedX Health	Gives helpful support in data-driven decisions.
Corti	AI-powered co-pilot for identification of symptoms and make decisions.
Atomwise	Provides prediction of potential medicine.
iCarbonX	Provides personalized healthcare products and services.
Generative AI and Large Language Models (LLMs)	Extensively employed in healthcare technology, integrating tools like ChatGPT into smart devices to support inquiries on health and well-being, sleep/relaxation quality, and personalised digital platforms. Med-PaLM, a competitor by Google and DeepMind (in turn specialised in predicting outcomes, screening breast cancer), is specifically trained for healthcare applications (Bakhshandeh, 2023) (Jindal *et al*., 2024).

In brief, healthcare organisations are adequately supported by IA in analysing – as a first crucial task commanded – patient/user data (profiled for both internal needs – administrative or management control – and external ones – services and information for the market) critical for improving healthcare outcomes. Managers and decision-makers are allowed to analyse patient/user records, treatment outcomes, and demographic information (given that professionals will identify effective treatments, improve clinical care protocols, and enhance overall healthcare quality by visualising trends and patterns; in addition, data are allowed to be integrated with patient engagement platforms, providing management insights into behaviors, preferences, and satisfaction, with information valuable for designing precise personalised care plans, enhancing communication, and overall patient/user experience as well, therefore the competitive advantage of the organisation). Also, managers' capabilities and competencies often result effectively integrated and boosted with reference to further activities as, where appropriate, operational efficiency optimisation (by analysing data related to resource allocation, staff performance, and patient flow, leading to better resource management, reduced wait times, etc.), disease management (through predictive analytics to forecast disease trends, identify high-risk patients, aid in preventive care, etc.), and other activities (regulatory compliance reporting, supply chain management, training and development, and patient engagement analytics).

In summary, from literature / scientific findings / reports and best practice cases examined, we draw that AI impacts the financial performance of healthcare entities through various and interesting managerial applications (Table 3).

Table 3 – AI impacts on the financial performance of healthcare entities

Impact / Application	Details
Cost and Revenue Cycle Management	Automated coding and billing accuracy contribute to faster reimbursement and reduced errors.
Fraud Detection and Prevention	Utilises advanced tools for safeguarding financial assets, preventing losses, and maintaining compliance with best risk management systems.
Patient Flow Optimisation	Controls admission rates and bed utilisation to reduce bottlenecks, minimise wait times, and maximise healthcare facility utilisation.
Personalised Medicine and Treatment Planning	Includes e-health, remote patient monitoring, and preventive care for customised patient treatment strategies.
Staffing Levels Optimisation	Helps avoid unnecessary labor costs by aligning staffing levels with periods of patient demand.
Financial Decision Support	Provides support for investments, budgeting, and resource allocation by analysing complex financial data, organising financial reports, and generating statements.
Most impacted sectors	Radiology (75% approved AI devices), Robotic Surgery (market share 24.5%), Drug Discovery (time reduction, from 5-6 years to about 1 year), Workflow Management (76% of healthcare professionals and users supportive), Medical Imaging (about 1/3 hospitals and imaging centers in US implement AI; in more detail, improving diagnostic accuracy by up to 20-30% for specific

Impact / Application	Details
	conditions, such as detecting breast cancer or lung nodules on CT scans, reducing false positives and false negatives, enhancing diagnostic accuracy and early disease detection). Thanks to improved operational performance enabled by sectoral benchmarking processes and intelligent automation - which allow for smarter triaging while reducing the manual workload of doctors and technicians, as well as minimising diagnostic equipment downtime - these sectors achieve reductions in service time and costs. This enhances financial performance. Additionally, with personalised protocols and tailored solutions, patients too benefit from expense savings and avoid unnecessary or incorrect examinations. Overall: AI adoption in healthcare organisations 94% (2023). *Data extracted from KhrisDigital, Grand View Research, Sci-Tech Today, medRxiv.* As regards Italy, AI in healthcare is progressively expanding, supported by significant investments, particularly within the framework of the National Recovery and Resilience Plan (PNRR). According to recent reports, the plan allocates 2.3 billion euros to healthcare digitisation, with one billion directed towards implementing telemedicine platforms across the country. Such platforms are designed to enhance remote patient monitoring, consultations, and digital health services. Overall, while Italy is making strides in digitalising healthcare and applying AI for improved patient care, efforts remain to overcome challenges related to data management, infrastructure, and cybersecurity. See *https://www.infodata.ilsole24ore.com/*

To conclude, the enormous potential of artificial intelligence (no longer a niche phenomenon) is taking place on a broad scale, revolutionising even the financial management of healthcare, improving operational efficiency, optimising the use of resources and enhancing decision-making processes. As long as healthcare organisations accurately integrate AI into their strategies, they are more likely to achieve a sustainable and resilient financial position (Macfarlane, 2014) while simultaneously delivering both improved patient care and operating efficiency/performances (and eventually value creation goal) (Lombrano & Iacuzzi, 2020). Similarly, with a detailed user profiling, there emerge advantages in terms of marketing management, because firms can create more effective, targeted, competitive and user-centric campaigns and services, e.g.: marketing contents personalised, patient segmentation improved, chatbots and virtual assistants, customer journey mapping, communication and engagement, digital advertising, appointment and service reminders, thus empowering the healthcare organisation's value chain (Porter, 1985).

6 – Emerging challenges, ethical considerations, and future trends

From the analysis above presented, we derive further considerations. We learn that the increasing penetration of AI in healthcare is bringing forth a wave of transformative potential, but not without challenges and ethical issues. As we traverse the intricate landscape of AI applications in health management and accounting, it becomes paramount to scrutinise the hurdles faced and the ethical imperatives that guide responsible deployment.

Since the implementation of AI in healthcare is not free of complexities, several challenges emerge, encompassing data interoperability, as health systems often operate on diverse platforms. Data quality and standardisation are crucial for AI algorithms to produce reliable results, posing a challenge in the face of varied data sources and formats. Moreover, algorithmic bias and interpretability issues demand attention because the opacity of some AI mechanisms may raise concerns about the fairness and accountability of automated decisions.

Also, the ethical landscape surrounding AI in healthcare demands meticulous attention. In this regard, Saheb, Saheb & Carpenter (2021) mapped the research strands of ethics of artificial intelligence in healthcare through a wide bibliometric and content analysis. By analysing relevant scientific articles on the ethics of AI in healthcare domain, four major ethical categories emerge: normative, meta-ethics, epistemological and medical practice. Additionally, seven more ethical sub-categories arise: ethics of relationships, medico-legal concerns, ethics of robots, ethics of ambient intelligence, patients' rights, physicians' rights, and ethics of predictive analytics. More recently, by illustrating the fairness of artificial intelligence in healthcare, Ueda *et al*. (2024) aim to provide a foundation for discussing the responsible and equitable implementation and deployment of AI in healthcare.

In such tangled perspective, data privacy emerges as a paramount concern (Santamato *et al*., 2024), patient information being highly sensitive and subject to stringent regulations. We draw that ensuring robust security measures to safeguard against data breaches becomes a duty. Major ethical considerations extend to the potential for bias in AI algorithms, possibly impacting healthcare delivery and exacerbating health disparities. Especially in critical areas as diagnostics and treatment planning, ethical implications of AI-driven decision-making underscore the need for transparency and fairness in algorithmic outcomes.

Furthermore, it is not uncommon for major healthcare organisations to publish ethical guidelines, participate in industry discussions, and factually collaborate with regulatory bodies to also ensure responsible, democratic and ethical use of AI. Looking forward, organisations are increasingly required to have frameworks, guidelines or initiatives to address ethical issues (especially associated to patient privacy, transparency, bias, accountability, and informed consent).

Therefore, to navigate challenges and ethical considerations, responsible AI deployment is necessary. Health firms should prioritise transparency in communicating the AI role in decision-making processes, fostering a sound relationship of trust with patients. Additionally, regulatory compliance is expected to be scheduled as an integral control governance task, necessitating adherence to data protection laws and industry standards. Moreover, continuous monitoring and auditing of AI would identify and rectify biases, ensuring AI systems align with ethical standards and societal values.

Consequently, the future of AI in health management and accounting is poised for continued innovation and transformative impact. Above all, predictive analytics is expected to play a pivotal role in anticipating healthcare trends, optimising resource allocation, and enhancing financial forecasting. At the same time, the emergence of explainable AI models (e.g., through the local interpretable model-agnostic and additive explanations; Srinivasu *et al*. 2022) would address the challenge of algorithmic interpretability, providing healthcare professionals and leaders with insights into the decision-making processes of more complex algorithms.

Also, it is worth noting that the integration of blockchain technology is addressing data security concerns by improving the integrity and traceability of healthcare transactions.

Collaborative efforts between interdisciplinary teams, including healthcare professionals, data scientists, and ethicists, therefore, are crucial in shaping the future trajectory of AI applications. Similarly, advancements in AI-driven robotics seem destined to revolutionise administrative tasks freeing up valuable human resources to focus more on patient care (it will be necessary to redeploy the human resources freed while trying not to impact unemployment).

Since there is still a vast territory to be explored, we finally realise that future implications of AI in healthcare extend beyond technological advancements. Ethical considerations are expected to stay at the forefront, guiding responsible AI adoption and ensuring that the transformative power of technologies aligns with the overarching goals of patient-centric care, operational efficiency, managerial / marketing effectiveness, and financial sustainability. In embracing the future of AI in health governance, a commitment to ethical practices and continuous adaptation to emerging challenges will be the cornerstone of a renewed, resilient and people-centred healthcare ecosystem. In fact, as highlighted by Makridakis (2017) several potential drawbacks and risks of AI implementation can be in general outlined, such as rising unemployment, wealth disparity, reduction of human dominance, and – at last? – the specter of a *technological singularity*.

7 – Conclusion

Due to its transformative impact across various industries and sectors, AI (performing tasks typical of human intelligence, such as learning, reasoning, problem-solving, language etc.) is a disruptive technology. Its integration into health management and accounting represents a profound paradigm shift, ushering in an era of innovation and efficiency in healthcare delivery. As we traverse the landscapes of data-driven decision-making, predictive analytics, and transformative patient care, it appears evident that the synergy between AI, health management, and accounting holds immense potential for reshaping the healthcare ecosystem.

Through the AI lens, healthcare organisations may gain the ability to optimise resource allocation, streamline processes, and enhance clinical / patient care outcomes. In fact, AI can better monitor the main healthcare KPIs identifiable in reviewed cases: a) Patient outcomes (mortality rate, patient satisfaction scores, readmission rates, etc.); b) Resource utilisation (bed occupancy rate, emergency department throughput, etc.); c) Financial metrics (revenue growth, operating margin, cost per patient, etc.). Such an intense "revolution" is not without challenges. The complexities of data interoperability, algorithmic bias, and ethical considerations reveal the opportunity of a nuanced approach to AI. Responsible deployment, guided by transparency, accountability, and commitment to patient trust, emerges as the lodestar for coping with these challenges.

The future trajectory of AI in healthcare organisations promises continued evolution. Predictive analytics are expected to better refine the ability to foresee healthcare trends, empowering administrations to proactively address challenges and allocate resources. Moreover, a greater integration of emerging technologies, such as blockchain, Internet-of-Things, big data ecosystems, and explainable AI, will further enhance the security and interpretability of artificial intelligence systems, contributing to a more robust and resilient healthcare infrastructure.

In conclusion, the transformative potential of AI extends beyond the realms of operational efficiency and financial improvement, by catalysing a powerful value-creation paradigm oriented to competitive advantage of healthcare business (Sheng *et al*., 2013) where patient-

centric care takes center stage, informed by 'responsible' AI practices. In other words, the success of this transformation would rest not just on technological and financial advancements but involve ethical principles to guide this deployment. As healthcare entities chart the AI frontier, a commitment to transparency, equity, and enduring values must ensure AI becomes a catalyst for a more adaptive, patient-satisfaction, and sustainable future.

While our study endeavors to shed light basically on the intersection of AI, health management, and accounting, it is essential to acknowledge the inherent limitations and delineate future directions that beckon further exploration and refinement. The main limitation regards the dynamic nature of technology, as well as contextual variances. On the one hand, new algorithms, models, and applications continually emerge, rendering certain aspects of the study subject to obsolescence; on the other, contextual nuances might not be fully captured in a comprehensive manner (the diversity of all healthcare structures and policies suggests that implications of AI adoption can differ significantly across regions). In other words, practices and case studies offer insights into the practical implications of AI, yet they are inherently selective. Therefore, the diversity of healthcare organisations worldwide implies that not all the facets of AI integration may have been exhaustively covered. Future directions entail the need of longitudinal studies or interdisciplinary collaboration, and the opportunity of patient-centric outcomes and regulatory / policy analysis. As such a complex field evolves, ongoing research endeavors will play a pivotal role in shaping the responsible and impactful integration of AI in the healthcare ecosystem. Among the future developments to overcome limitations, the decomposition of the healthcare sector into distinct industries (sub-sectors: pharmaceutical and biotechnology industries, medical device, industry, health consulting, finance, sport-related, etc.) may be judicious. Similarly, the explicit consideration of different environmental factors can be influenced by diverse cultures and propensities for innovation. Also, it might be appropriate to decouple public healthcare and private services, highlighting varying roles and balances. Eventually, the relationship between IA management accounting and financial performance (plus non-financial) could be quantitatively researched for in future (e.g., with a regression model or a SEM).

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