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An AI-driven Low-Code Framework for Healthcare System Digital Transformation

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Abstract

The healthcare sector is under increasing pressure to optimize operational efficiency, reduce administrative burdens, and enhance patient-centric services; all while maintaining strict regulatory compliance. This study investigates the integration of Robotic Process Automation (RPA) with low-code development platforms as a transformative approach to healthcare automation. The study proposes a comprehensive framework that leverages low-code RPA to automate complex, rule-based processes, including electronic medical record (EMR) updates, insurance claims processing, and compliance reporting, without requiring extensive software development expertise.

Using system architecture modeling, workflow analysis, and proof-of-concept implementation, this research evaluates the technical efficacy, scalability, and security of low-code RPA solutions in healthcare environments. Key contributions include a domain-specific methodology for identifying automation candidates, a modular orchestration model for RPA deployment, and performance metrics demonstrating improvements in task execution time, accuracy, and resource utilization. The study also addresses critical challenges, including interoperability with legacy healthcare information systems, data privacy (e.g., HIPAA compliance), and governance of autonomous processes.

Keywords: Low-code platforms, Blockchain, Interoperability, Agentic AI, Multi-agent AI

Introduction

The healthcare industry must improve operational efficiency, reduce administrative burdens, and enhance patient-centered services, all while maintaining strict compliance with regulatory standards (Rocco, et al., 2021). Although Albania has made progress in healthcare digitalization, healthcare systems still lack effective information sharing. To improve interoperability, researchers suggest what is genuinely needed in healthcare, including common standards, shared identifiers, consistent medical terminology, and secure communication systems. Additionally, the authors recommend the use of open-source platforms, such as OpenHIM, to connect to different systems. The research emphasizes that improving interoperability would make healthcare more efficient and better coordinated (Dasho, Natarajan, & Kuneshka, 2023).

Research conducted by the World Health Organization (WHO) indicates that Albania has made progress in strengthening primary health care, particularly through expanded preventive check-ups. However, the system continues to face significant challenges. Some of the challenges include limited follow-up for chronic diseases, inconsistent quality of services, shortages of staff and diagnostic equipment, and outdated infrastructure (Tushe, 2025). Healthcare data systems remain largely paper-based, and there is no integrated national electronic health record system. A key recommendation is the development of a unified family-medicine model tailored to Albania’s urban and rural needs (World Health Organization, 2016).

According to this study (Tushe, 2025), Artificial Intelligence (AI) improves diagnostic accuracy, automates routine tasks, and supports clinical decision-making. In nursing practice, AI reduces administrative workload, enhances patient monitoring, and enables early diagnosis and prediction. However, Albania remains in the pilot stages of AI due to limited resources, outdated infrastructure, and a lack of training for healthcare workers. Despite these barriers, the government has shown interest in modernizing healthcare as AI offers significant opportunities through training programs and investment initiatives. The study emphasizes that nurses will play a critical role in integrating AI into Albanian healthcare by supporting and enhancing technological implementation rather than replacing human workers.

This study (Avokati Popullit, 2024) reports that the Albanian government announced in 2022 that 95% of its services had been digitized. In healthcare, this development includes digital processes for doctor referrals, reimbursement of prescriptions, and even medical reporting.

In this research (Emeka Okeke & Demola Akinbolajo, 2023), the authors examine the integration of AI and automation within low-code platforms. These platforms are drag-and-drop interfaces that include embedded technologies, such as machine learning (ML) and natural language processing (NLP). They improve operational efficiency and are widely used by non-technical users with limited programming experience. Additionally, they enable automated workflows, predictive analytics, and decision-making. However, the authors highlight challenges using these platforms with AI and automation, including data quality, skill challenges, and security risks. The study further suggests that advancements in AI technologies will play a major role in the future development of low-code platforms.

(Ukeje, 2023) emphasizes that low-code and no-code platforms can help professional workers, particularly nurses and physicians, to develop applications quickly without extensive coding experience. The study recommends providing structured training and technical support for healthcare staff, offering real-time development previews, and ensuring strong data security. Additionally, the author suggests keeping instructions for using these platforms simple while integrating them with medical systems. Overall, the study supports the use of low-code and no-code platforms for streamlining healthcare workflows and improving the accuracy and efficiency of patient care.

(Hofmann, 2023) indicates that Albania has made progress in digitalizing electronic prescriptions, referrals, and sick leave documentation, which reduce errors and save time in primary care. However, compared with countries such as Denmark, Estonia, and Slovenia, Albania continues to rely heavily on paper records; national electronic health records are not used, and clinics do not connect with the national system. Additional challenges include weak digital infrastructure and insufficient workforce training. Overall, Albania needs to digitalize medical records, improve interoperability across systems, and strengthen the digitalization in healthcare.

According to the study by (Gjika, Qurku, & Pano, 2023), digital technologies, especially telemedicine, are transforming the healthcare system in Albania. The country has introduced electronic prescriptions, telemedicine centers, and digital healthcare tools across both public and private sectors. However, the country still has challenges in the healthcare system, such as limited infrastructure, a lack of staff training, and administrative burdens. Survey findings from multiple hospitals suggest that telemedicine reduces costs, saves time and improves healthcare accessibility. The authors conclude that Albania has initiated its transition toward digital health; however, it must invest in updated technology and a stronger legal framework to reach the full potential of telehealth.

Albania's healthcare system is predominantly public but is supplemented by private healthcare providers. The country has experienced significant digital transformations in digital technologies, driven by an increasing demand for modern healthcare services. Digital health initiatives have expanded with the rise of telemedicine and mobile health apps; however, these systems remain fragmented and not connected to the national electronic health system. According to the research (Kadiu, Kosova, & Kosova, 2025) Albania, compared to other Balkan countries, is prepared to adopt healthcare digital transformation. Nevertheless, challenges persist, including weak data systems, low spending in research and development, and restricted use of AI in clinical practice. The country needs a stronger infrastructure and more investment to move forward with the improvement of digitalization in healthcare (Kadiu, Kosova, & Kosova, 2025).

The countries in the Western Balkans - including Bosnia and Herzegovina, Kosovo, Montenegro, and North Macedonia have made major progress in their healthcare systems, particularly in primary healthcare, by the creation of electronic health records, digital appointments, and e-prescriptions (Open Data Institute, 2023). However, these countries are short in innovation, research, and health-system planning. Countries like Montenegro and Serbia have made progress with real-world data initiatives, but they struggle with outdated infrastructure and limited interoperability. Overall, the region shows momentum in healthcare digitalization but must shift from basic digitalization to a more advanced (mature) one (Open Data Institute, 2023).

According to a very recent study (Jevtic, 2025), countries in the Western Balkans (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia) face similar healthcare challenges. The most common ones are – shortage of staff, high out-of-pocket payments, and gaps in digital healthcare. All countries share outdated infrastructure, limited funding, and inequalities between rural and urban areas. The need is to modernize digital healthcare and better integrate with European Union (EU) standards to build a more equitable healthcare system in the region.

Kosovo is far behind in developing a fully functional electronic healthcare system, which is required to join the European Union's healthcare network. The country lacks a health information system (HIS), which is essential for online medical records, digital prescriptions, and the implementation of health insurance. Drafting a strategic plan for the years 2024-2030 remains slow due to problems such as outdated infrastructure and untrained staff to run or maintain systems. In addition, the implementation of health insurance has been delayed, making it difficult to access EU-level digital health services. Modernizing eHealth in the country is very urgent because it delays citizens' access to services (Maloku, 2025).

Furthermore, according to (Bahtiri & Selmani, 2023), Kosovo's digital public healthcare system is underdeveloped and has repeatedly failed to implement a functional Health Information System (HIS). That is because of weak infrastructure, limited IT capacity, and insufficient training of healthcare staff. Despite the efforts to implement the eKosova platform, healthcare institutions rely heavily on paper-based records; it lacks standardized digital procedures and suffers from funding shortages that slow modernization. Additional challenges in the healthcare system include low digital literacy among older patients and senior healthcare workers, and unequal access to digital tools. All the above make it impossible to adopt a fully modern digital healthcare system and adapt to EU standards.

Problem statement

Healthcare systems are experiencing workforce shortages, increasing administrative workload, and a fragmented digital infrastructure. In Albania, the healthcare system remains largely paper-based, demonstrates limited interoperability among healthcare information systems, and relies on outdated technology infrastructure. Globally, healthcare systems also struggle to process large volumes of data because traditional systems cannot efficiently process or interpret complex healthcare information.

The urgency to adopt low-code automation and AI-driven workflows in Albania and the broader Western Balkan region arises from a combination of structural, demographic, and systemic pressures that traditional digitalization approaches can no longer adequately address. Healthcare systems in Albania and Kosovo continue to confront significant workforce shortages, with hospitals operating below optimal staffing levels and aging medical personnel struggling to meet rising service demands. Rising patient volumes and the rapid growth of chronic diseases (which require continuous follow-up and generate massive amounts of data that paper-based, fragmented systems cannot manage efficiently) further intensify these pressures. Additionally, the Western Balkan region faces considerable geographical disparities as rural and remote communities often lack access to medical specialists, diagnostic infrastructure, and reliable internet connectivity, making routine medical care difficult to access and often delaying diagnosis and treatment.

Low-code platforms and AI workflows provide a practical path forward because they require minimal coding expertise and can be implemented incrementally, beginning with administrative processes, digital forms, referral management workflows, and telehealth triage systems. These technologies can automate high-volume and repetitive tasks that consume clinician time, reduce bottlenecks in patient flow, help standardize documentation, and provide digital services even in infrastructure-limited settings. By lowering the technical barrier and reducing development costs, low-code frameworks enable healthcare institutions in Albania and Kosovo to bypass years of slow, expensive digitalization efforts and instead adopt modular, scalable systems capable of delivering immediate efficiency gains. In this context, AI-enhanced low-code technologies are not optional innovations—they represent a practical and urgent response to systemic constraints that have long hindered the modernization of healthcare systems in the Western Balkans.

Impact of this study

In this study, we put forward the following arguments:

1. Traditional healthcare automation primarily relies on rule-based scripts that are non-adaptive, limited to repetitive tasks, and require explicit human coding for each modification. In contrast, autonomous, proactive systems, referred to as agentic AI workflows are driven by Natural Language Processing (NLP) and Machine Learning (ML). These systems can interpret context, adapt to new scenarios, and support decision-making with minimal human intervention. By automatically summarizing clinical notes, reducing documentation time, and improving consistency across patient records, agentic AI enhances both accuracy and efficiency. This improves clinical quality and administrative productivity.
2. Healthcare environments experiencing staffing shortages often face extended waiting times and heavy administrative workloads, making low-code platforms particularly valuable. These tools enhance patient engagement by enabling the rapid development of SMS reminders, symptom-checking applications, and chronic-disease monitoring workflows with minimal technical expertise. In telehealth, low-code platforms streamline processes such as digital intake forms, automated follow-up messaging, and scheduling through intuitive drag-and-drop interfaces. From an administrative perspective, these platforms automate appointment management, billing workflows, referral routing, and digital form processing, replacing paper-based procedures and reducing staff workload.
3. AI-enabled tools reduce hospital administrative burden by automating routine tasks such as documentation, scheduling, and data entry, freeing clinicians from time-consuming clerical responsibilities. These systems can also provide real-time alerts for abnormal laboratory results, allowing clinicians to respond promptly to urgent medical conditions. By double-checking clinical decisions and identifying discrepancies, AI helps reduce medical errors and improve patient safety. Together, these capabilities remove repetitive,

mundane workloads that contribute to burnout, lowering stress and enhancing clinician well-being.

4. Blockchain-integrated AI frameworks enhance healthcare data management by establishing a shared, tamper-resistant data infrastructure, enabling hospitals and clinics to exchange information more easily and reliably. These frameworks also support secure AI training approaches—such as federated learning—which allow algorithms to be trained across multiple institutions without exposing or transferring raw patient data. This combination strengthens privacy protections, improves interoperability, and enables advanced analytics without compromising sensitive health information.
5. Multi-agent AI frameworks can outperform single-agent systems because multiple agents can operate in parallel, significantly improving task execution and reducing processing time. This design also allows the system to manage more complex, multi-step workflows—such as those found in hospitals—where tasks may need to be coordinated, delegated, or dynamically reassigned. As a result, multi-agent systems are more flexible, scalable, and better suited to real-world healthcare operations compared to single-agent frameworks.
6. Low-code development platforms provide significant benefits, including accelerated application development, reduced operational and engineering costs, and the ability for non-technical staff to build or customize digital tools. These advantages help healthcare organizations innovate quickly without large IT teams. However, limitations include licensing costs and restrictions in advanced customization, which may restrict the ability to build highly specialized or fully bespoke systems when needed.
7. AI-enabled tools can reduce disparities in healthcare access by supporting remote monitoring, telemedicine, and virtual consultations—services that are especially crucial in rural areas with limited clinical resources. These technologies can assist with early disease detection when local providers are unavailable, helping patients receive timely assessments and referrals. Overall, AI reduces care delays, expands access to medical expertise, and improves healthcare quality for underserved populations.
8. AI-powered virtual agents enhance patient satisfaction and clinical workflow efficiency by collecting essential information before appointments, reducing staff workload, and shortening visit times. They automate basic tasks such as intake, triage, reminders, and frequently asked questions, helping clinical teams focus on higher-value patient care. By speeding up processes and reducing

bottlenecks, virtual agents contribute to smoother operations and a more positive patient experience.

This study aims to examine how low-code automation, agentic AI workflows, multi-agent systems, and blockchain can be integrated into Albania’s healthcare system. Since the same issues are encountered in the Western Balkans, this study is relevant to other countries, including Kosovo, North Macedonia, and Montenegro. The research addresses challenges, such as paper-based records, poor interoperability, administrative burden, and a shortage of healthcare staff. The study focuses on improving diagnostic accuracy, reducing clinician burnout, enhancing workflow efficiency, and strengthening data privacy by proposing a framework that supports Albania’s early-stage healthcare digital transformation.

Related Work

Agentic workflows are revolutionizing healthcare by enhancing efficiency, supporting clinical decision-making, and improving the overall delivery of patient care. (Joy, 2025) states that global AI will reach USD $102.7 billion by 2028. It is crucial to understand how agentic workflows in healthcare work – they use artificial intelligence (AI) to automate tasks while operating autonomously and simultaneously. In contrast to traditional automation, these agentic workflows use natural language processing (NLP) and machine learning (ML) to mimic human cognitive functions. As a result, better processing time and enhanced accuracy are achieved in clinical documentation and administrative tasks (Joy, 2025).

According to a recent study by (Laxman Mhatre, 2024), 86% of healthcare companies use AI daily, and 25% of US hospitals use AI to predict diagnostic results. The problem the author states is data overload; data is entered manually, which takes time and is prone to error. Another problem is patient engagement: as the number of patients increases, it becomes harder to respond to all inquiries promptly. In addition, diagnosing diseases and providing prescriptions are challenges. AI automation can solve all these problems by screening through Electronic Health Records (EHRs) to determine trends in patients' data. Furthermore, AI algorithms use natural language processing to understand human intent and generate responses for chatbots and virtual assistants. Lastly, AI algorithms can diagnose diseases more quickly and accurately than doctors can and recommend appropriate prescriptions.

Healthcare workers spend over 34 percent of their time on administrative work. In addition, medical errors cause 100,000 deaths every year in the USA (Georgiou, 2023). Automation can provide solutions for administrative tasks and help prevent medical errors. The healthcare industry is facing challenges, such as staff shortages, burnout, and rising costs.

Automation can help address these issues. The study indicates that automation can lower costs, help alleviate staffing shortages and burnout, support paperless workflows, expand access to care, and strengthen health outcomes (Georgiou, 2023).

Low-code platforms in healthcare serve as automation tools for non-technical workers, automating manual workflows and improving patient engagement. Specifically, they help clinicians and other healthcare professionals develop automated solutions with minimal coding experience.

Furthermore, low-code platforms offer prebuilt templates with drag-and-drop interfaces that improve the efficiency of healthcare tasks (Kemi Atobatele, Oluwanifemi Ajayi, Qudus Hungbo, & Adeyemi, 2023).

Low-code and no-code platforms play a crucial role in different industries, including healthcare. Traditional AI often requires high costs and long development cycles. They are reinventing AI-driven applications, as they require minimal technical programming knowledge (Viswanadhapalli, 2025). These platforms are drag-and-drop interfaces that automate workflows by lowering costs. Chatbots use these platforms to build predictive models for disease diagnosis and to automate administrative tasks. Lastly, pharmaceutical companies use them to analyze patients' responses to drugs.

According to another study (Kummaragunta, 2024), the population of 60 years and older is expected to almost double by the year 2050. Therefore, the demand for health services will rise. A solution to healthcare services has been Artificial Intelligence. AI can predict diagnostic outcomes in the early stages of disease by analyzing historical data. In addition, Machine Learning (ML) algorithms, based on historical patient data, can predict outcomes. Early treatment of patients based on these predictions can reduce hospital admissions. For example, a patient's historical data (features) can predict the risks of heart failure or diabetes. Natural Language Processing (NLP) is another AI tool that processes unstructured clinical data, such as patient notes, lab reports, and patient historical data, into structured data. This way, the burden is taken off healthcare staff by automating the extraction and processing of Electronic Health Records (EHRs), allowing them to focus more on patient care (Kummaragunta, 2024).

The research study by (Oluremi, 2025) proposes a Blockchain-Integrated AI Framework that combines AI and Blockchain to address data privacy and interoperability. The framework has a multilayer architecture combined with AI analytics. The three main layers of the framework are the Blockchain Layer, the AI Layer, and the Privacy-Preservation Layer. The first layer ensures data integrity; the second layer ensures model training; and the third layer ensures the confidentiality of AI model training. The experiments of the framework show a high accuracy of 88% and a strong blockchain performance. In the future, the author plans to evaluate the framework in real-time hospital environments.

A study, conducted by (Thomas & Edward, 2023), proposes a framework that is made of four primary components, which include Data Management, Model Development, Compliance and Security, and Deployment and Monitoring. The purpose of this framework is to develop a structured and systematic approach to AI-enabled healthcare technologies that are reliable, safe, and deployable in real clinic settings. The main purpose of the framework is to connect AI models with real-world healthcare deployment.

A very recent study, conducted by (Jenko, et al., 2025), emphasizes the work of an AI agent that takes information from sensors, processes it to learn, and then acts on specific goals, mostly independently. They adapt quickly to changes and make decisions that are driven by their objectives. In healthcare, an AI agent is a virtual assistant or a chatbot that assists patients with tasks, such as setting up appointments, scheduling reminders, or even checking symptoms. In addition, the research focuses on the deployment of AI in healthcare in a safe, ethical, and trustworthy manner. It highlights that successful AI in healthcare requires not just technical accuracy but also compliance, interpretability, and integration into clinical workflows.

The study by (Mhatre, 2023) emphasizes the challenges faced by healthcare contact centers, including high workloads, poor response times, and cost pressures. A response to these challenges is generative AI, which, in other words, is an algorithm in the form of bots that can respond in text, video, or audio formats. These systems can function as virtual agents, automating procedures and responding to patients in real-time. According to the study, approximately 82% of healthcare centers have adopted generative AI in their operations.

A multi-agent framework for pre-consultation purposes is proposed by (ChengZhang , et al., 2025). The agents play a proactive role in determining which department the patient should go to, understanding the patient’s symptoms, and summarizing the main reason for the visit or complaint. The main coordinator then decides on the next step of the process and whether sufficient information has been collected. The framework was assessed using more than 1,000 medical records and has demonstrated high accuracy in identifying the appropriate department for patient referral. Accordingly, the AI system performs tasks that are similar to those carried out by clinicians.

In their study (Fagbenle, Khameneh, & Solomon, 2024), the authors emphasize that many countries worldwide face healthcare challenges, including physician shortages, rural population distribution, and limited infrastructure. The development of low-code platforms, such as Microsoft

Power Platform, can help healthcare staff automate workflows, create dashboards, and develop Chatbots. These platforms provide user-friendly drag-and-drop interfaces and can function without extensive programming knowledge. The United States and other countries, such as India, for mental health screening in students, use these tools. The study highlights that low-code technology, when paired with effective training, can help underserved populations by reducing long-term costs. In healthcare, cloud-based automation tools are used to automate administrative tasks such as appointment scheduling and insurance verification (Mogili, 2025).

Non-technical users of visual programming first used the term low code in 2014 to describe simplified software development processes. It was predicted that by 2025, 70% of new applications would be developed using low-code platforms. Robotic Process Automation (RPA) is commonly implemented using low-code platforms and offers advantages over traditional automation, including increased productivity, increased accuracy, lower technological barriers, and reduced costs. However, RPA without AI would not produce significant transformational improvements. The integration of RPA with Natural Language Processing (NLP) or Machine Learning (ML) in general can enhance automation, such as invoice processing (Söylemez, 2024).

A study by (Ness & Hansen, 2019) addresses the benefits of low-code development compared to traditional programming, including speed, innovation, scalability, and availability for non-technical users. The study highlights how low-code development can reduce the time of application deployment from 2.7 years to 13 weeks. Another important advantage is rapid innovation, which allows experimentation with new ideas at lower cost than traditional development approaches. While low-code development is often associated with small businesses, the study shows that it has also been implemented in enterprise environments and small development teams. Additionally, low-code development helps address workforce shortages by allowing non-technical users to participate in software development.

MedCoAct has been proposed as a multi-agent platform with doctor and pharmacist agents that collaborate in diagnostics and medication recommendations. In addition, a dataset, named DrugCareQA, has been introduced to support the workflows. The research demonstrates that the accuracy of the platform outperforms that of a single-agent platform by an average of 7.04% in diagnostic accuracy and 7.08% in recommendation accuracy (Zheng, Shi, & Yi, 2025).

Research has been conducted to demonstrate the use of a multi-agent system (MAS) for transitions from virtual agents to real multi-robot teams operating in a high-stakes environment. The main tasks of robots are autonomous transportation of supplies, indirect support of patients, and response to emergencies. The results of the research demonstrate that robotic teams can increase efficiency and sustainability, although challenges remain in managing failures and in the daily integration with existing hospital workflows (Bai, Ding, & Taylor, 2025).

As traditional hand-coding technology cannot keep up with demand, the need for low-code platforms has grown. Low-code platforms are drag-and-drop interfaces combined with hand-coding for automation. They are visual component platforms. In the research study by (Hallberg, 2021), the Mendix platform was used, which is a visual drag-and-drop platform that integrates with JavaScript, Java, and CSS. The research also speaks of citizen developers, who are citizens with no technical background and create applications for a team. In this study, the platform is used to combine all health information systems and get patient data. It is important to highlight key challenges, such as data quality issues and the need for developer attention and supervision. He argues that low-code platforms are sufficient for collecting patient-generated healthcare data and sending it to electronic health record (EHR) systems. In addition, it is argued that although basic functioning can be achieved through low-code platforms, there are functions that still require additional hand-coding. His research emphasizes that simple, basic tasks can be done through platforms, while speeding up the process; however, there are still challenges and missing features that make it hard to adapt. He concludes that low-code platforms are handy but not practical enough for building patient data in healthcare.

According to a study (Balakrishnan, et al., 2025), the rural population is often short of healthcare services. That is due to the geographic location, limited infrastructure, or shortage of staff. In contrast, AI uses tools such as Machine Learning (ML) and Natural Language Processing (NLP) to address these gaps by supporting remote diagnostics and improving clinical decision-making. For example, ML algorithms can help predict diseases such as cancer and CAD (coronary artery disease), thereby improving healthcare in rural areas.

The research study by (Garodia, 2024) introduced Quantum Generative Adversarial Networks (QGAN), a hybrid approach that combines quantum computing and generative adversarial networks. He explains that their job is to automate the supply chain and enhance the capabilities of language models. Along with QGAN, the author explains Large Language Models (LLMs), which are used to enhance patient care by natural language interfaces. However, both technologies pose challenges, such as the complexity of computations and the interpretation of decisions in QGAN; in LLMS implementations of clinical workflows, this challenge requires proper training and acceptance of healthcare staff. That is, LLMs should enhance clinical decision-making and not replace humans.

In their research, (Rony, Parvin, & Ferdousi, 2023) highlight the importance of AI in healthcare, and more specifically in nursing practice. AI helps nursing personnel process huge amounts of data, enabling them to identify clinical abnormalities and improve diagnostic accuracy in the early stages of illness, whereas afterwards, they can personalize treatment plans. Prior research indicates that AI can automate administrative tasks, allowing nurses to have more time for patient treatment. In their research, the authors on the other side highlight challenges, including interoperability issues, clinician hesitancy, and concerns over reliability. To conclude, the article stresses the importance of AI in nursing practice as an enhancement to the practice, not a replacement of human work.

AI technologies made of machine learning (ML), deep learning (DL), large language models (LLMs), and natural language processing (NLP) can help in different areas of clinical practice, including early disease detection, improving diagnostic accuracy, and enhancing clinical decision-making. In labs, AI supports automation, increasing speed and accuracy while reducing human error (Alowais, et al., 2023). While adopting AI in clinical practice, challenges arise, including algorithmic bias, interoperability issues, ethical concerns, and the production of incorrect output known as hallucinations. Medical schools need to train and collaborate with humans to ensure safe and efficient use of AI in clinical practice.

Despite advances in large language models (such as LLMs), so-called world models and spatial intelligence are expected to govern the future of AI beyond language models (Zhang, et al., 2026). In other words, even if the most advanced LLMs have sufficient knowledge available, they would not be able to make innovations, such as inventing new theories or making discoveries (Zahavy, Tom; Google DeepMind, 2026).

In their research, (Chalasani, Syed, Ramesh, Patil, & Kumar, 2023) highlight the importance of Artificial Intelligence in pharmacy practice. By using Machine Learning (ML) and Deep Learning (DL), technology enables personalized treatment for patients, rather than relying solely on algorithms. Like other fields of healthcare, AI in pharmacy has enhanced workflow automation and efficiency, enabled more precise procedures, and improved overall patient care. However, challenges still exist when using AI in pharmacy practice. The research indicates the three most common challenges: data privacy, bias in AI models, and data integration. Since substantial amounts of sensitive data are processed, the potential of sharing improper data exists. The next challenge is bias in algorithms, which leads to inequalities and inaccurate predictions, and lastly, the risk of overfitting or algorithms that perform well in small datasets but not in real settings is a challenge as well. All these barriers must be overcome for AI to be adopted correctly in pharmacy practice.

In a review study (Elendu, et al., 2023), the authors reviewed the ethical challenges of AI and robotics in healthcare. The authors briefly mention the benefits that AI introduces, such as personalized patient treatment, better efficiency, and diagnostics. In addition, they point out the challenges that still exist within AI in healthcare. Their concerns are transparency and accountability, as well as the protection of human autonomy. They also indicate the risk of job loss due to robotics in healthcare and the potential for inequality if AI is not implemented carefully. They recommend strong ethical frameworks for proper and trustworthy use of robotics and AI in healthcare.

In a very recent study (Chen, et al., 2025), the role of Generative AI in healthcare is highlighted. Their work demonstrates how generative AI can reproduce text, images, and enormous amounts of data to support diagnosis and drug discovery. However, the research indicates that the full adoption of Gen AI in healthcare is hindered by data fragmentation and a lack of infrastructure that supports data and model continuity. The authors introduce SAGE-Health, an ecosystem that combines raw and semantic medical data. That is, the system combines data management with Generative AI models and agent-based layers. This way, a cycle is created to improve data quality and model performance. The authors emphasize that only in this way can the ecosystem deliver meaningful healthcare solutions.

According to (Liu, et al., 2025), medical AI agents are significantly different from traditional AI, which does one thing at a time. These AI agents are used for planning, action, reflection, and memory. All four capabilities allow these AI agents to serve as digital assistants. They can help with personalized treatment plans, support diagnosis, and assist with robotic surgery. The authors illustrate challenges that come along, such as the risk of biased outcomes, data privacy, and fairness. Despite the challenges, they see the future as an AI agent hospital.

In his research (Nikhil, 2025), the author describes Low-Code platforms which are designed for people with minimal technical skills, also known as citizen developers. These platforms are fast, user-friendly at the interface, and offer drag-and-drop workflows. The benefits offered by the platforms include lower costs and shorter development cycles. On the contrary, the author highlights the challenges that remain in the development of these platforms, such as security risks and limitations to complex systems. The author predicts that by 2026, the number of citizen developers will surpass the number of professional programmers.

The study by (Nweke, Ogadah, Koshechkin, & Oluwasegun, 2025) emphasizes the importance of multi-agent AI, which, compared to traditional AI, is faster and more accurate. Unlike traditional AI that relies on a single system, multi-agent systems operate in parallel, each doing its own job. They work on checking medical images, reading patient records, and predicting risks, as well as assisting doctors in choosing treatment. They can also help the medical field by diagnosing diseases, planning treatment for diseases such as cancer, and speeding up emergency care. However, the research highlights the challenges that multi-agent AI faces, such as protecting patient data, avoiding bias and unfair outcomes, and making AI decisions for doctors easy to understand.

According to (Rabbani, et al., 2025), generative AI is remaking healthcare through large language models (LLMs) and multi-modal systems. Generative AI can generate text, images, and synthetic data for a variety of healthcare applications, including medical education, administration, and clinical care. Clinicians use LLMs to draft notes and patient messaging while significantly reducing administrative burden. Generative AI can generate synthetic MRI/CT scans, diagnose complex diseases, and detect rare abnormalities. However, despite the positive aspects of Generative AI, the authors express caution about sensitive information, such as hallucinations or misreading content, and bias. From the perspective of this study, generative AI can enhance clinicians' work by personalizing care plans and improving efficiency but not replacing it.

Blockchain can improve healthcare by decentralizing medical data and addressing issues, including data fragmentation and weak interoperability. Blockchain provides features such as traceability, decentralization, and transparency. Technology supports real-time data sharing among hospitals and labs while reducing costs. There are challenges in healthcare, such as scalability and the need for more efficient algorithms. In summary, blockchain could make healthcare more reliable and transparent as technology advances (Andrew, et al., 2023).

The study by (Fonsêca, et al., 2024) highlights that blockchain is used to make healthcare information systems safer, more reliable, and easier to share. More precisely, they emphasize that blockchain can improve privacy and allow hospitals to share patient information without relying on a centralized system. The authors indicate the benefits of blockchain in healthcare systems, such as improved security and transparency, but also note that blockchain faces challenges, including high storage needs and performance limitations. Taken together, they emphasize that blockchain has the potential to improve data management in healthcare; however, it must be integrated to fit the needs of today's healthcare systems.

Based on research, three case studies are relevant to the topic of this research. They are as follows:

a) *Telemedicine in rural communities* – The research of a health clinic in Minnesota demonstrates that during the pandemic years, the clinic was able to use telehealth for its patients. The clinic could be paid for phone and video visits. However, as the number of COVID-19 patients decreased, usage dropped. In addition, the clinic also encountered barriers, such as limited technology, poor internet, and high turnover of staff. The research illustrates that telehealth can be effective in rural areas; however, it requires adequate support (Anderson & Singh, 2021). Another study on telehealth in rural areas highlights that a combination of telemedicine and AI can be effective. As stated in the study, telemedicine enables patients to consult doctors from the comfort of their homes, whereas AI helps doctors analyze data, predict diseases at preliminary stages, and make clinical decisions. The combination of telemedicine and AI makes health care more accurate, easier to access, and more effective in identifying disease patterns. However, there are also challenges, including limited internet access, high technology costs, and a lack of training (Nwankwo, Emeihe, Ajegbile, Olaboye, & Maha, 2024).

b) *Blockchain applications in Electronic Health Records (EHRs)* – The study of blockchain in healthcare by (Nandhakumar, Gorrepati, & Kareem, 2024) illustrates the case studies of Estonia and MIT's MedRec. Estonia is considered a pioneer in utilizing blockchain for all medical records, ensuring interoperability among healthcare providers and maintaining security. Whereas MIT's MedRec project utilizes smart contracts and blockchain to give patients the authority to view their health records while creating a decentralized system across multiple hospitals and an auditing system. According to these case studies, the research highlights how blockchain can enhance healthcare transparency and patient-centered care.

c) *Digitalization of health* – According to (European Commission , 2023), five EU member countries, which are Belgium, Estonia, Croatia, Czechia, and Denmark have started to digitalize healthcare by improving telemedicine, enhancing primary care and interoperability, and upgrading digital infrastructure. Despite challenges, such as the need for coordination, the initiative for digitalization is supporting remote care (through telemedicine), enhancing decision-making, and innovation.

Existing literature shows that artificial intelligence, low-code and no-code platforms, robotic process automation, multi-agent systems, and blockchain technologies can individually improve healthcare efficiency, interoperability, and data management. However, most studies examine these technologies in isolation or focus on healthcare systems in high-income countries with mature digital infrastructures. There is limited synthesized evidence on how these technologies can be integrated into a unified framework suitable for healthcare systems at an early stage of digital transformation. Healthcare systems in Albania and the wider Western Balkans continue to face challenges, including paper-based workflows, limited interoperability, administrative burden, workforce shortages, and rural–urban disparities. Despite these constraints, no comprehensive review has examined how low-code and AI-driven automation frameworks could be adapted to such contexts. This review addresses this gap by synthesizing existing evidence and contextualizing it for Albania and comparable Western Balkan healthcare systems.

Methodology

The research employs a qualitative approach, collecting information solely from secondary data, including peer-reviewed articles, case studies, and official reports from international organizations. The data is relevant to AI in healthcare, low-code platforms, multi-agent systems, telemedicine, and blockchain (all of which are related to healthcare). The methodology is well designed to address challenges in Albania's healthcare, such as paper-based workflows, poor interoperability, administrative burden, and rural healthcare inequalities. The literature is organized into themes related to the research questions. The main themes of the literature review are:

- Agentic AI workflows
- Low-code automation
- Multi-agent systems
- Blockchain data sharing
- Rural telemedicine
- Infrastructure barriers

Real-world case studies such of Estonia's blockchain-enabled national Electronic Health Records (EHRs) and MIT's MedRec are included to compare their mature digital healthcare systems with Albania and Kosovo's digital infrastructure, which is at an early stage. Based on the research findings, areas of improvement include increasing interoperability, reducing workload to lower administrative burden, and improving efficiency. The methodology identifies areas for system-wide improvement—such as interoperability, workload reduction, and data governance—to guide the adaptation of an AI-enabled low-code framework suitable not only for Albania but also for other Western Balkan countries facing similar constraints.

This review included peer-reviewed journal articles, conference papers, review studies, policy reports, and official publications from international organizations that addressed the use of low-code platforms, artificial intelligence, agentic or multi-agent systems, robotic process automation, blockchain, or digital health technologies in healthcare contexts.

Studies were included if they discussed healthcare applications, system frameworks, implementation challenges, or real-world case studies relevant to healthcare digitalization. Studies focusing exclusively on non-healthcare domains, purely technical implementations without healthcare relevance, opinion pieces without substantive discussion, or articles lacking sufficient contextual or conceptual detail were excluded or highlighted in the Discussion section. The included studies were grouped thematically for narrative synthesis according to their primary focus areas, including low-code automation, agentic AI workflows, multi-agent systems, blockchain-based data sharing, telemedicine in rural healthcare, and infrastructure and governance challenges.

Methods

In this study, we employed WebXplore (Nidumolu, 2020), a web search engine. The thematic queries and the databases used for this search are summarized in Table 1. We used six thematic queries and four databases. Table 1 shows the total number of unique articles for each theme.

Table 1: Thematic queries and databases included in this study

Thematic Queries	Databases	Total unique articles
Low-code AI-driven framework in healthcare	PubMed, arXiv, Semantic Scholar, OpenAlex	21
Agentic AI workflows in healthcare		35
Multi-agent systems for healthcare		30
Blockchain data sharing in healthcare		30
Rural telemedicine implementation		30
Healthcare infrastructure barriers		39

Results

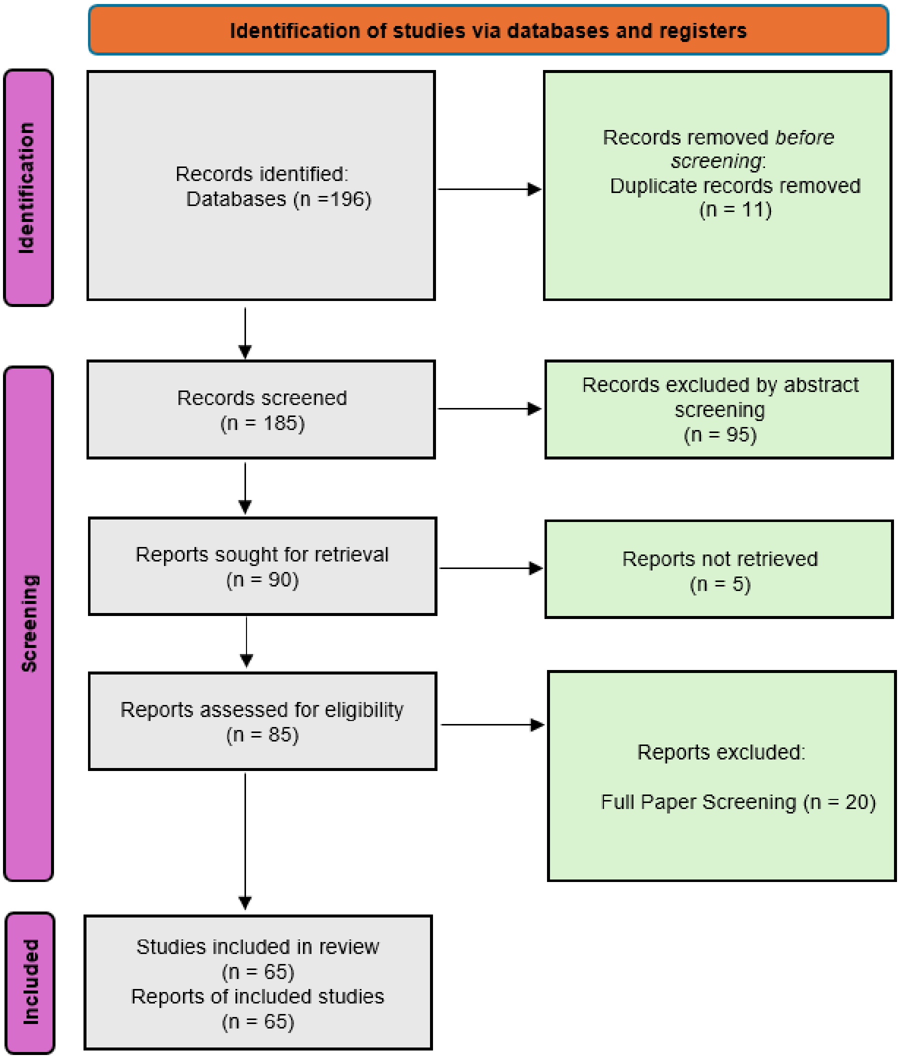

Figure 1 presents the summary of the PRISMA 2020 diagram (Page & al., 2021). In addition, Table 1S summarizes the unique list of articles for each theme, as an Excel Spreadsheet file (see Supplementary Information). A Python script to perform the web search is also included in the Supplementary Information.

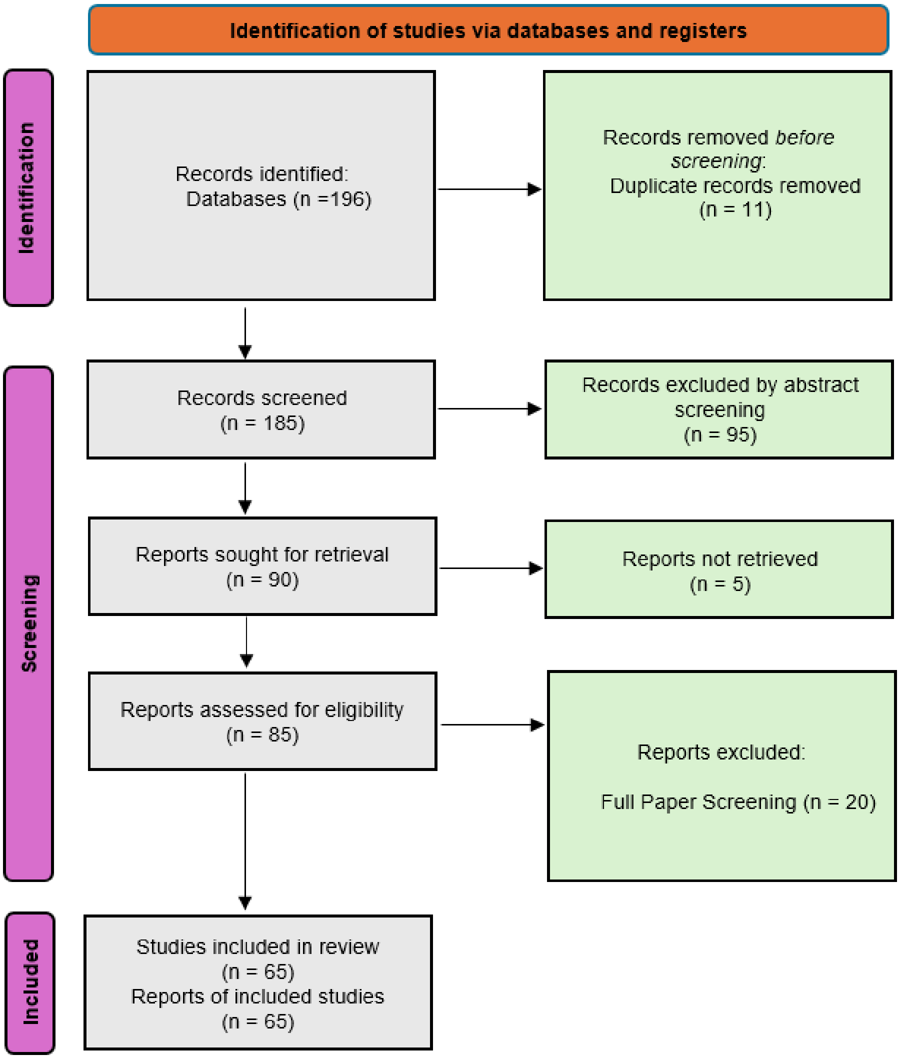

Figure 1: PRISMA 2020 diagram (Page & al., 2021) of the systematic literature review conducted in this study

Discussion

General remarks

The research analyzes how low-code platforms, together with agentic AI and multi-agent AI workflows, can be the much-needed transition to digitalizing healthcare in Albania and the Western Balkans. They can assist with paper-based records, fragmented infrastructure, and with a shortage of healthcare staff. Traditional coding can be expensive and provides limited benefits when compared to complex healthcare workflows. Multi-agent AI functions in parallel but still needs human oversight, which is not yet consistent within the region.

Citizen developers can quickly and easily implement low-code platforms. However, they can carry a risk on their own as well; without correct governance, they can lack long-term support and consistency. On the other hand, blockchain frameworks can face similar challenges. On the one hand, they can improve data integrity and trust; on the other hand, they face challenges such as scalability and technical complexity, which can limit their immediate usability. Since in Albania and Kosovo (and the rest of the West Balkans) the digitalization of healthcare is in its initial stages, the implementation of low-code platforms and agentic AI is better demonstrated in case studies rather than the entire healthcare systems.

Albania reflects the challenges of the entire region in terms of weak digital infrastructure, lack of staff training, and rural-urban inequalities. AI-driven telemedicine and automation can improve access to care for underserved communities and reduce administrative burden. However, it still needs investment in infrastructure and staff training. A recommendation for future research would be pilot implementation to analyze if these technologies are sustainable, affordable, and appropriate for healthcare systems in the region, and more specifically for Albania.

Perspectives

As the quantum computers (QMs) era of advanced computing is approaching, quantum computing offers a transformative computational methodology to the healthcare industry by accelerating and enhancing diagnostic precision and making effective use of resource allocation. Emergence of QMs, as a modern technology, can shape the future of advanced computing and the healthcare industry (Deloitte Consulting LLP, 2025).

AI ethics and safety

As the use of AI is increasing across disciplines, ethical and safety challenges are arising. These relate to the ethical use of personal data, given harmful biases, and discrimination. In addition, AI-based technologies may face safety challenges due to the misuse of the data or malicious use of the algorithms in the design. For instance, algorithms can be biased toward unfair and inaccurate medical diagnoses, inadequate treatment, and exacerbated healthcare disparities; see, for example, (The Royal Society, 2024) and the references therein. Furthermore, the use of algorithmically biased data to train AI models can pose risks.

This study emphasized that ML and DL tools have been widely applied in the field of healthcare, aiding disease prediction. However, the accuracy and generalization of the ML models are still a challenging task because of the black-box nature of these models and because they are trained using various real-world problems and input data. For instance, healthcare data are often detained, multi-model, and fragmented, collected using different methods, and thus highly unstructured and in various formats. Often, the healthcare data is costly and subject to constraints. For instance, gathering and labelling healthcare data of rare diseases is expensive and time-consuming. In addition, maintenance of big datasets is a challenge. Generative AI models can be effective in producing data of the required standards (Healy, 1973; World Health Organization, 2024).

Data sensitivity is another issue in healthcare data due to the constraints on its governance, management, and privacy. Often, anonymity is used as a matter of course. However, the resources needed to share that data while maintaining privacy at the same time are the main problems when dealing with sensitive data.

Therefore, to maximize the benefit of AI in healthcare, strategies must be introduced, such as coordinated efforts in sharing the data, unification, and control of the data. International, regional, and inter-institutional collaboration aiming at the creation of centralized datasets for use in training the ML-based models may be a solution. Data pooling initiatives (at the global or regional level) are efforts of creating the so-called global registers that enable standardization of datasets (Bellgard, Snelling, & McGree, 2019).

To broaden access of the data resources and maintain the importance of collaboration, other initiatives have also been established, such as the establishment of multi-stakeholder cooperation networks. Moreover, the use of generative AI techniques can be effective in addressing data scarcity, noise, or missing data, for example, through data augmentation (Kokosi & Harron, 2022).

Reproducibility

Reproducibility is another challenge in ML-based science (Kapoor & Narayanan, 2023), particularly in healthcare research studies (McDermott, et al., 2021). This has questioned the research integrity and trustworthiness of AI-based models (The Royal Society, 2024). That is because failure to reproduce the results of a research study compromises the validity of a particular investigation. In addition, it affects other research results on failed AI models (The Royal Society, 2024) and the references therein (Kapoor & Narayanan, 2023).

The challenges in reproducing the research results relate to the opacity of the AI model, particularly its black-box nature of the ML model. Currently, the ML-based models are used by all scientists of almost all disciplines, and not all are able to understand, explain, and interpret them (The Royal Society, 2024), particularly the mathematics behind ML-based models (Prince, 2023). Opacity of ML-based models increases when using commercial software and proprietary datasets, which reveal only limited information about the model system architecture or data.

Difficulties in reproducing results of research results using AI-based models relate to a range of factors (The Royal Society, 2024). These include the use of statistical methods to reduce bias and the exclusion of outliers from interpretations of results. Furthermore, the use of different software (or computer architectures) and training datasets of varying sizes and transparencies can cause failure to reproduce research study results. Healthcare-based data have limited access, are less transparent, and are proprietary. Moreover, the failure to reproduce AI-based model results relates to the discipline-specific documentation of the datasets, lack of training for new AI-based model researchers, and lack of career opportunities for academic staff in the position of reproducible research results (such as data curation, wrangling, research data management, and others) (The Royal Society, 2024).

To overcome the problems with the interpretation of the black-box nature of ML-based models, discipline-specific AI-based interpretable models are introduced (Rudin, 2019), such as PyHealth (a Python library for healthcare AI models) (Yang, et al., 2023), biomedicine (Carlo, et al., 2022), material science (Zhong, et al., 2022), chemistry and drug discovery (Bharath, et al., 2019), and environmental science (Arashpour, 2023).

Furthermore, efforts to increase the transparency of black-box models have been made by introducing so-called glass-box architecture AI-based models (Lengerich, et al., 2023).

Conclusion

The research shows that low-code platforms, together with AI and blockchain, help to digitalize the healthcare system in Albania and the Western Balkans. The technologies combined can reduce paper-based healthcare records, improve data sharing, and support the shortage of staff in healthcare. Low-code platforms are quick and easy to build, whereas AI automates tasks and workflow routines while reducing errors and increasing efficiency. Blockchain, on the other hand, adds a layer of security and trust within the data. To conclude, the proposal of a low-code AI-supported platform can really help digitalize healthcare in Albania, but it also needs proper training, governance, and infrastructure.

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