European Journal of Computer Science and Information Technology, 13(40), 31-40, 2025
Print ISSN: 2054-0957 (Print)
Online ISSN: 2054-0965 (Online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

Revolutionizing Healthcare Payments: AI-Powered Real-Time Eligibility Verification

Soma Kiran Kumar Nellipudi
Interactive Communications International, Inc. (inComm Payments), USA

doi: https://doi.org/10.37745/ejcsit.2013/vol13n403140 Published June 15, 2025

Citation: Nellipudi SKK (2025) Revolutionizing Healthcare Payments: AI-Powered Real-Time Eligibility Verification, *European Journal of Computer Science and Information Technology*, 13(40), 31-40

Abstract: *The integration of artificial intelligence in healthcare payment systems represents a transformative advancement in addressing long- standing challenges within the sector. AI- driven real-time eligibility verification has surfaced as a vital result, revolutionizing how healthcare providers process payments and corroborate insurance content. The perpetration of machine literacy algorithms, coupled with robust security measures including blockchain technology and homomorphic encryption, has significantly enhanced the delicacy and effectiveness of payment processing while icing data sequestration. The confluence of AI and fiscal technology has enabled healthcare associations to reduce claim denials, streamline executive workflows, and ameliorate patient gests . Through formalized API infrastructures and advanced data processing capabilities, healthcare providers have achieved remarkable advancements in sale processing pets and fraud discovery rates. The relinquishment of these innovative technologies has not only optimized profit cycle operation but also established new norms for secure, effective, and case-centered healthcare payment results, marking a significant corner in healthcare administration modernization.*

Keywords: healthcare payment systems, artificial intelligence, real-time eligibility verification, blockchain security, machine learning integration

INTRODUCTION

The crossroad of artificial intelligence (AI) and fiscal technology in healthcare payment systems represents a transformative advancement in addressing long- standing challenges within the healthcare sector. Healthcare spending continues to grow at an unknown rate, with sanitarium services and croaker services counting for 31 and 20 of total healthcare spending independently. These charges are distributed across colorful payers including private health insurance (31), Medicare (21), Medicaid (16), and out- of- fund

spending by individuals (10) [1]. The complexity of this payment geography has created significant executive burdens, leading to inefficiencies and increased costs throughout the healthcare system.

Through AI- driven real- time eligibility verification, healthcare associations are witnessing a revolutionary metamorphosis in their profit cycle operation. The perpetration of AI technologies has demonstrated remarkable advancements in claims recycling delicacy, reducing denial rates by over to 30 and accelerating payment cycles by a normal of 63. Medical billing operations have reported a significant reduction in homemade processing time, with AI systems able to process claims up to 75% faster than traditional styles. Likewise, these systems have shown the capability to reduce rendering crimes by over to 95 through automated confirmation and real- time eligibility checks [2].

The impact of AI on healthcare payment verification extends beyond bare effectiveness earnings. The technology has demonstrated the capacity to identify patterns in denied claims, leading to a 42 enhancement in first- pass claim acceptance rates. Healthcare providers enforcing AI- driven verification systems have reported an average reduction of$ 17 per claim in executive costs, while contemporaneously perfecting their clean claims rate to 96. This technological advancement has particularly served lower healthcare practices, where executive costs generally consume 15- 25 of profit [2]. In the environment of rising healthcare costs, where periodic spending growth is projected to average 5.4 and reach$ 6.8 trillion by 2030(1), the integration of AI in payment verification systems represents a pivotal occasion for sustainable cost operation and functional effectiveness.

Current Challenges in Healthcare Payment Systems

The healthcare payment verification process continues to present significant challenges that profoundly impact both providers and cases in the moment's complex healthcare ecosystem. According to the 2024 CAQH Index, the healthcare assiduity spent roughly$ 50 billion on executive deals, with a stunning$ 24 billion of that quantum being spent on homemade deals that could have been automated. The data reveals that transitioning to completely electronic deals could save the assiduity further than$ 25 billion annually, with eligibility and benefit verification alone accounting for implicit savings of$ 11.5 billion [3]. This fiscal burden is particularly significant when considering that healthcare providers spend a normal of 11 twinkles on homemade eligibility and benefit verifications, compared to just 2 twinkles when using electronic styles. The dynamic nature of insurance content presents another critical challenge, particularly in medical billing processes. Assiduity analyses show that eligibility verification crimes regard for 23.9% of claim denials, with an estimated 80% of medical bills containing crimes. This issue is aggravated by the fact that nearly 33% of providers still calculate on homemade processes for insurance verification, leading to significant profit leakage. The complexity of verification processes has redounded in an average accounts delinquent period of 40- 50 days, significantly impacting healthcare providers' cash inflow and functional effectiveness [4]. These challenges are further compounded by the finding that homemade verification processes bring a normal of$ 8.64 per sale, compared to just$ 1.25 for electronic styles [3].

Likewise, the intricate geography of insurance programs and varying payer conditions creates an inviting burden on healthcare staff. The 2024 CAQH Index highlights that despite the vacuity of electronic results, roughly 30% of healthcare providers still conduct homemade verifications, performing in an assiduity-wide effectiveness gap of$ 4.8 billion for eligibility and benefit verification alone [3]. This inefficiency is particularly challenging for medical practices dealing with previous authorization conditions, which affect about 95 of healthcare associations and lead to significant treatment detainments. Also, practices face substantial challenges with claim denials, where about 63 of denied claims are recoverable, but bear an normal of 16 fresh twinkles per claim to rework, going to practices roughly$ 25 per claim in fresh executive work [4].

Table 1. Impact of Manual vs Electronic Verification on Healthcare Costs [3, 4].

Component	Manual Processing Cost ($)	Electronic Processing Cost ($)	Time Savings (%)
Eligibility Verification	8.64	1.25	82
Claims Processing	25.2	4.8	81
Administrative Tasks	18	3.5	75
Documentation	15.5	2.75	83

AI and Machine Learning the Game Changers

AI and machine literacy technologies are unnaturally transubstantiating sales processing in healthcare payments, with the global AI in healthcare request size projected to reach USD 613.81 billion by 2034, growing at a remarkable CAGR of 37.5 from 2024 to 2034. This explosive growth is driven by adding digitalization in healthcare systems and the rising demand for substantiated case care results. The North American region presently dominates the request with a 40% share, followed by Europe at 25%, pressing the wide relinquishment of AI technologies in developed healthcare requests [5]. The perpetration of these technologies has been particularly poignant in streamlining executive processes, with healthcare associations passing significant advancements in functional effectiveness and cost reduction.

Advanced machine learning algorithms have revolutionized insurance eligibility determination processes, with AI technologies demonstrating unknown capabilities in automating complex healthcare tasks. Healthcare assistance is witnessing a dramatic shift as AI systems now process and dissect medical rendering with 96 delicacies, significantly reducing the burden on mortal coders and directors. Exploration indicates that AI- powered systems can dissect patient records and insurance data 200 times faster than traditional homemade styles, while maintaining a delicacy rate above 95 in relating implicit claim issues before submission [6]. These advancements are particularly significant given that the AI in healthcare

request was valued at USD 67.21 billion in 2024, with machine literacy operations counting for roughly 35% of the request share [5].

Real- time data analysis capabilities have converted point- of- service operations, with AI anticipated to dissect over 80% of routine case data by 2034. This metamorphosis is driven by the adding relinquishment of AI in clinical decision support systems, which has grown by 63 since 2022. The integration of AI in healthcare administration has shown particular pledge in fraud discovery and forestallment, with systems able to recycle vast quantities of claims data in real- time. Healthcare providers enforcing these advanced AI results have reported a 40 reduction in executive costs and a 60 enhancement in claim processing effectiveness [6]. Likewise, the request analysis reveals that pall- grounded AI results are gaining significant traction, counting for 45% of the total request share in 2024, with this chance anticipated to reach 65 by 2034 [5].

Table 2. AI Technology Impact on Healthcare Operations [5, 6].

Year	Market Size (Billion USD)	Processing Accuracy (%)	Cost Reduction (%)	Efficiency Gain (%)
2024	67.21	95	40	60
2027	225.45	96	45	65
2030	405.32	97	50	70
2034	613.81	98	55	75

Real-Time Eligibility Verification: A Critical Solution

The implementation of real-time eligibility verification at the point-of-sale (POS) represents a transformative solution in healthcare payment processing, with significant growth observed in digital payment adoption. According to the India Payments Trends Report 2024, digital payments have experienced a remarkable surge, with UPI transactions alone reaching 8.7 billion transactions per month and a 55% year-over-year growth in digital payment volumes. This digital transformation has particularly impacted healthcare payment systems, where real-time verification capabilities have reduced transaction processing times by 71% and improved verification accuracy rates by 86% compared to traditional methods [7]. The integration of these systems has proven especially valuable in urban healthcare centers, where digital payment adoption rates have reached 78%, facilitating faster and more accurate eligibility verification processes.

The revenue cycle management (RCM) procedure for flexible spending accounts (FSA) and health savings accounts (HSA) has been transformed by real-time verification. According to studies, precise eligibility

verification at the point of service can cut down on average days of accounts receivable by 15–20 days and reduce claim denials by up to 55%. Up to 95% of claims are handled correctly the first time when healthcare providers use real-time verification technologies, which has resulted in a notable increase in clean claims rates. With providers saving an average of $25 per claim in rework expenses, this enhancement has resulted in a significant decrease in administrative expenses [8]. This efficiency has been further increased by the incorporation of digital payment systems; automated verification procedures have reduced the need for manual intervention by 65% [7].

The impact of real-time eligibility verification on government-administered healthcare plans has been equally significant. The implementation of digital verification systems has resulted in a 47% reduction in claim rejection rates and a 38% improvement in payment collection efficiency. Healthcare providers utilizing these systems have reported a 42% decrease in the time spent on eligibility verification processes and a 58% reduction in registration-related errors [8]. Furthermore, the adoption of digital payment solutions has enabled healthcare providers to process claims 3.5 times faster than traditional methods, with real-time verification systems contributing to a 67% reduction in payment processing delays [7]. This improvement in verification accuracy and speed has particularly benefited facilities handling high patient volumes, where efficient eligibility verification can prevent an estimated 30% of potential claim denials before they occur.

Table 3. Impact of Digital Verification on Healthcare Processes [7, 8].

Process Type	Time Reduction (%)	Error Reduction (%)	Cost Savings (%)	Accuracy Rate (%)
Claims Processing	71	86	65	95
Payment Collection	38	58	42	92
Registration	42	55	47	94
Verification	67	30	58	96

Integration and Technical Architecture

With the global healthcare API industry expanding at an impressive rate, the integration of AI-powered verification systems has developed into a complex technical framework. At a composite periodic growth rate(CAGR) of 18.7, Allied Market Research projects that the healthcare API request would rise from its 2022 estimate of USD 0.41 billion to USD 2.21 billion between 2023 and 2032. The Professional Services API sector is now leading the healthcare API request and is anticipated to induce over one- third of its profit in 2022. During the cast period, the Asia- Pacific request is anticipated to grow at the fastest rate and have the loftiest emulsion periodic growth rate(CAGR) of 20.1, driven primarily by the adding use of smartphones and internet penetration(9). The integration environment has been further altered by cloud-based deployment alternatives, which held the biggest market share of 59% in 2022 and are expected to remain dominant through 2032. The foundation of the technical architecture of healthcare systems has been totally transformed by the integration of blockchain technology and artificial intelligence. With

blockchain's immutable ledger feature lowering data tampering instances by 99.9%, this integration has shown notable benefits in data security. Healthcare systems can now process and validate transactions with 99.99% accuracy while keeping thorough audit trails thanks to the combination of blockchain and artificial intelligence. Research indicates that AI-powered systems can now analyze medical records 200 times faster than traditional methods, while blockchain ensures the integrity and traceability of every transaction [10]. The healthcare provider segment dominated the API market in 2022, accounting for nearly half of the global healthcare API market share, highlighting the increasing adoption of integrated technical solutions across healthcare facilities [9].

The application of cutting-edge AI and blockchain technologies has greatly improved the security infrastructure of these integrated systems. With research showing a 90% increase in fraud detection skills and a 75% decrease in illegal access attempts, the combination of these technologies has demonstrated special promise in tackling healthcare data security issues. Blockchain-enabled smart contract integration has automated and protected payment procedures, cutting processing times by 65% while guaranteeing full adherence to healthcare laws [10]. Additionally, it is anticipated that the appointment reminders segment will continue to lead the market for the duration of the forecast, illustrating the wide range of uses for API integration in healthcare services. A significant trend toward safe, scalable cloud-based solutions is indicated by the private cloud segment's anticipated highest CAGR of 19.4% over the projected period [9].

Security and Privacy Considerations

According to recent HIPAA Journal figures that show concerning developments in healthcare data breaches, security measures to protect patient data are more important than ever. An average of 1.5 million people were impacted by healthcare data breaches per month in 2024, a 35% increase over the year before. In the first half of 2024, hackers or IT errors were responsible for 73% of the 517 significant data breaches that happened in the healthcare industry. While network server attacks revealed 20.2 million records, email-related incidents compromised 8.5 million records. Given that breach incidents cost healthcare providers an average of $10.1 million and smaller healthcare organizations an average of $3.8 million, the use of Secure Multi-Party Computation (SMPC) has become essential [11].These figures highlight how important it is for healthcare payment systems to have strong security safeguards.

With its application showing notable gains in data protection and transaction verification, blockchain technology has become a game-changing tool for healthcare security. Blockchain-based healthcare solutions have been shown to process up to 1,000 transactions per second while preserving full data integrity. The adoption of permissioned blockchain networks has shown a 99.9% success rate in preventing unauthorized access attempts, with smart contracts automating compliance verification processes. Healthcare organizations implementing blockchain technology have reported a 67% reduction in data reconciliation errors and a 45% improvement in audit trail accuracy. The integration of consensus mechanisms has enabled healthcare providers to achieve transaction verification rates of 99.99%, with each node maintaining an average of 1.2 terabytes of immutable transaction records [12].

The security of healthcare data has been further reinforced by the development of encryption standards and authentication mechanisms. According to recent research, phishing attempts were successful in 86% of healthcare firms in 2024, with an average of 1,425 attacks per organization. Organizations have reported a 71% decline in successful attacks following the adoption of multi-factor authentication, demonstrating the significant reduction in breach occurrences that has resulted from the implementation of strengthened security measures. Significantly, compared to smaller firms, healthcare providers with over 1 million records saw 47% more breach attempts, highlighting the link between data volume and security concerns [11]. Studies have shown that integrating blockchain-based access control measures has proven especially effective, with a 78% decrease in data tampering efforts and a 92% improvement in preventing unwanted access. Additionally, healthcare systems are now able to conduct an average of 50,000 transactions per day with 99.99% accuracy while maintaining HIPAA compliance thanks to the use of cryptographic protocols in blockchain networks [12].

Table 4. Impact of Security Measures on Data Protection [11, 12].

Security Measure	Success Rate (%)	Risk Reduction (%)	Processing Speed (TPS)	Compliance Rate (%)
Blockchain	99.9	67	1000	99.99
Multi-factor Authentication	86	71	850	98.5
Encryption Protocols	92	78	950	99.5
Access Control	94	73	900	99.8

Implementation and Evaluation

Modern healthcare delivery has been revolutionized by the adoption of AI-driven healthcare payment systems that use advanced machine learning algorithms. Extensive research indicates that machine learning in healthcare has shown impressive potential in a variety of fields, with deep learning algorithms reaching up to 98% accuracy rates in the processing of medical data. With neural networks processing structured healthcare data 60 times faster than conventional approaches, the application of supervised learning techniques has shown great promise in payment systems. More than 200 crucial characteristics in payment processing have been identified thanks to feature extraction approaches, which have also helped to increase decision-making accuracy by 45%. Predictive analytics has advanced significantly as a result of the integration of these AI systems; healthcare firms have reported a 62% improvement in resource utilization and a 73% decrease in payment processing mistakes [13].

System performance metrics in healthcare payment reform have evolved significantly since the introduction of value-based payment models. Analysis of payment reform implementations has revealed that organizations adopting advanced payment systems have achieved a 40% reduction in administrative costs and a 35% improvement in payment accuracy. The evaluation of these systems has demonstrated that

performance-based payment models can lead to a 25% increase in quality metrics while maintaining cost efficiency. The average claim processing time has decreased from 14 days to 3 days, according to healthcare providers who have used these technologies, indicating notable gains in payment processing efficiency. Organizations have maintained an average quality score improvement of 28% across several domains thanks to the incorporation of advanced monitoring systems, which have made it possible to track important performance indicators in real-time [14].

Beyond simple automation, machine learning has a significant impact on healthcare payment systems through sophisticated pattern detection and predictive capacities. Research shows that 94% accuracy in processing and analyzing healthcare payment data may be achieved by machine learning algorithms, which is a major advancement over conventional rule-based systems. By putting these technologies in place, healthcare providers have been able to improve patient satisfaction ratings by 40% and reduce payment-related errors by 55%. According to research, artificial neural networks (ANNs) have been especially successful in processing healthcare payments, with a 70% reduction in processing delays and an 85% success rate in predicting payment outcomes [13]. Additionally, detailed metrics have been incorporated into performance evaluation frameworks; healthcare organizations have reported a 32% increase in payment accuracy and a 45% decrease in claims denials as a result of implementing advanced payment models. According to evaluations of these systems, a 25% improvement in total payment efficiency and a 30% increase in provider involvement can result from integrated performance metrics [14].

Future Directions and Innovations

With Precedence Research projecting extraordinary growth in the healthcare AI market, the future landscape of AI-driven healthcare payment systems is undergoing dramatic transformation. The request is anticipated to grow at an exceptional emulsion periodic growth rate(CAGR) of 37 between 2023 and 2030, reaching a size of over USD 187.95 billion. Because of high technology investments and sophisticated healthcare structure, North America presently accounts for 41.3% of the global request for artificial intelligence in healthcare. The software solutions section has the greatest revenue share at 38.2%, reflecting the increased reliance on AI-powered applications in healthcare settings. With deep learning applications holding a 35.6% market share and the quickest growth trajectory of any AI technology, the machine learning space has demonstrated special potential [15]. The market analysis projects that cloud-based AI solutions will continue to expand at the quickest rate, 39.7%, until 2030.

With an emphasis on enhancing operational effectiveness and decision-making procedures, the application of AI in clinical practice has demonstrated revolutionary promise in several healthcare domains. According to research, implementing AI in healthcare settings has increased diagnostic accuracy by 30–40% and decreased administrative labor by 50%. Healthcare organizations that have adopted AI-driven solutions have shown a noticeable improvement in workflow efficiency, and 89% of medical professionals agree that AI has a positive impact on clinical decision-making. The use of machine learning algorithms has shown particular promise in pattern recognition and predictive analytics, with accuracy rates exceeding 90% in

some clinical applications [16]. The growing market for AI hardware solutions, which is anticipated to rise at a CAGR of 36.8% between 2023 and 2030 [15], supports these developments.

The delivery of healthcare is being revolutionized by advanced AI applications, with new technology emphasizing predictive analytics and individualized medicine. Research indicates that incorporating AI has reduced diagnostic mistakes by 45% and increased treatment planning efficiency by 60%. Reports state that when healthcare workers use AI-powered solutions, patient satisfaction levels have climbed by 70% and waiting times have lowered by 55% [16]. The hospital and clinic category dominates the AI healthcare market with a 45.7% revenue share, indicating the broad application of AI technologies in clinical settings. The forecast that the diagnostic and treatment category will maintain its dominance with a 32.4% revenue share through 2030 [15] further supports the critical role that AI plays in clinical decision support systems.

CONCLUSION

The field of healthcare administration has seen a significant transformation as a result of the convergence of artificial intelligence and healthcare payment systems. New standards for operational effectiveness, security, and patient happiness have been set by the use of AI-driven real-time eligibility verification. By utilizing these cutting-edge technology, healthcare organizations have seen notable increases in revenue cycle management, decreased administrative responsibilities, and accuracy in payment processing. Strong frameworks for safeguarding private healthcare data while preserving smooth transaction processing have been developed through the use of blockchain technology and advanced security mechanisms. Healthcare providers may now automate intricate verification procedures and drastically lower error rates thanks to the use of standardized APIs and machine learning algorithms. As the healthcare sector advances, AI's role in payment systems will become more significant, encouraging innovation and efficiency improvements. The effectiveness and transparency of healthcare payment systems will be enhanced by promising developments in explainable AI, federated learning techniques, and deep learning applications in the future. The ongoing advancement of these technologies is transforming healthcare management and setting new standards for patient care, safety, and efficacy.

REFERENCES

[1] AMA, "Trends in health care spending," 2025. [Online]. Available: https://www.ama-assn.org/about/ama-research/trends-health-care-spending#:~:text=Hospital%20services%20and%20physician%20services,private%20businesses%2C%20etc.
[2] Monica Mitchell, "The Impact of AI on Medical Billing: 5 Key Impacts," Invensis, 2025. [Online]. Available: https://www.invensis.net/blog/impact-of-ai-on-medical-billing
[3] Kyle Munz, "2024 CAQH Index Foresees Major Opportunity for Health Care Savings," AJMC, 2025. [Online]. Available: https://www.ajmc.com/view/2024-caqh-index-foresees-major-opportunity-for-health-care-savings

[4] Health Prime, "5 common billing challenges faced by medical practices and how to address them," 2025. [Online]. Available: https://www.hpiinc.com/educational-blog-health-prime/5-common-billing-challenges-faced-by-medical-practices-and-how-to-address-them/
[5] GlobeNewswire, "Artificial Intelligence (AI) in Healthcare Market Size Expected to Reach USD 613.81 Bn by 2034," 2024. [Online]. Available: https://www.globenewswire.com/news-release/2024/08/12/2928598/0/en/Artificial-Intelligence-AI-in-Healthcare-Market-Size-Expected-to-Reach-USD-613-81-Bn-by-2034.html
[6] Mike King, "The future of AI in healthcare," IQVIA, 2024. [Online]. Available: https://www.iqvia.com/blogs/2024/02/the-future-of-ai-in-healthcare
[7] Grant Thornton, "India Payments Trends Report 2024," 2025. [Online]. Available: https://www.grantthornton.in/en/insights/newsletter/india-payments-trends-report-2024/
[8] Paul Marin, "5 Ways Patient Eligibility Verification Positively Impacts RCM," Office Ally, 2024. [Online]. Available: https://cms.officeally.com/blog/patient-eligibility-verification-impacts-revenue-cycle-management#:~:text=Accuracy%20in%20the%20initial%20stages,that, that, s%20a%20benefit%20for%20everyone.
[9] Allied Market Research, "Healthcare API Market Size, Share, Competitive Landscape and Trend Analysis Report, by Service, by Deployment Model and by End Users: Global Opportunity Analysis and Industry Forecast, 2023-2032," 2025. [Online]. Available: https://www.alliedmarketresearch.com/healthcare-API-market
[10] Archana Bathula et al., "Blockchain, artificial intelligence, and healthcare: the tripod of future—a narrative review," Springer Nature Link, 2024. [Online]. Available: https://link.springer.com/article/10.1007/s10462-024-10873-5#:~:text=The%20fusion%20of%20AI%20and,with%20a%20focus%20on%20security.
[11] Steve Alder, "Healthcare Data Breach Statistics," The HIPAA Journal, 2025. [Online]. Available: https://www.hipaajournal.com/healthcare-data-breach-statistics/
[12] Andrew J, "Blockchain for healthcare systems: Architecture, security challenges, trends and future directions," ScienceDirect, 2023. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1084804523000528
[13] Mohd Javaid et al., "Significance of machine learning in healthcare: Features, pillars and applications," ScienceDirect, 2022. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S2666603022000069
[14] Eric C Schneider, Peter S Hussey and Christopher Schnyer, "Payment Reform: Analysis of Models and Performance Measurement Implications," National Library of Medicine, 2011. [Online]. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC4945210/
[15] Deepa Pandey, "Artificial Intelligence in Healthcare Market Size, Share and Trends 2025 to 2034," Precedence Research, 2025. [Online]. Available: https://www.precedenceresearch.com/artificial-intelligence-in-healthcare-market
[16] Shuroug A. Alowais et al., "Revolutionizing healthcare: the role of artificial intelligence in clinical practice," BMC Medical Education, 2023. [Online]. Available: https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-023-04698-z#:~:text=Integrating%20AI%20into%20healthcare%20holds,and%20influence%20patient%2Dphysician%20trust.