The Economic Impact of Artificial Intelligence in Medical Imaging

Florin Condrea
Institute of Mathematics of the Romanian Academy "Simion Stoilow",
Bucharest, Romania
condreaflorin22@gmail.com

Abstract

This study examines the economic impact of artificial intelligence in medical imaging, analyzing market trends and implementation mechanisms. The research reveals significant market growth, with the U.S. AI healthcare sector projected to reach USD 187.7 billion by 2030, growing at a CAGR of 35.8%. Analysis of workflow optimization demonstrates substantial efficiency gains, with reading time reductions up to 52.57% in concurrent reading scenarios and contouring time improvements between 30-50%. These findings indicate AI's transition from emerging technology to essential healthcare tool, suggesting continued innovation and value creation in medical imaging applications.

Key words: artificial intelligence, medical imaging, economic impact, healthcare market, workflow optimization
J.E.L. classification: O33, M15

1. Introduction

Artificial Intelligence stands as a transformative force in the global economy, with projections indicating potential value generation of $2.6 trillion to $4.4 trillion annually across analyzed use cases (McKinsey & Company, 2023). By 2030, the cumulative global economic impact of AI adoption is expected to reach $19.9 trillion, driving 3.5% of global GDP (IDC, 2024). The technology demonstrates remarkable efficiency in value creation, with every new dollar invested in business-related AI solutions projected to generate $4.60 in economic returns by 2030 (IDC, 2024).

The integration of Artificial Intelligence (AI) in healthcare represents a transformative force, with potential to revolutionize patient care while generating substantial economic benefits. Recent studies estimate healthcare cost savings of 5% to 10% through AI adoption, equivalent to $200-360 billion annually in the United States alone (Sahni et al., 2024). Within this landscape, medical imaging emerges as a particularly promising domain for AI implementation, with the market valued at $1.01 billion in 2023 and projected to reach $11.76 billion by 2030.

In this study, we conduct a comprehensive analysis of AI's economic impact specifically within medical imaging, examining both market dynamics and value creation mechanisms. Our research aims to bridge the current gap in economic impact studies, as identified by systematic reviews showing that only 6 out of 66 publications contained substantial economic analysis (Wolff et al., 2020).

2. Theoretical background

The adoption of AI in healthcare has been characterized by rapid technological advancement coupled with careful implementation considerations. In medical imaging, AI applications span across multiple modalities including X-ray, CT, MRI, and ultrasound, with particular emphasis on workflow optimization and diagnostic accuracy enhancement (Pinto, 2023).

The industry landscape shows significant investment, with more than half of AI/ML-based medical devices approved in the USA and Europe between 2015-2020 being focused on radiological applications (129 (58%) devices in the USA and 126 (53%) devices in Europe). Studies demonstrate

AI's ability to meet or exceed human expert performance across multiple specialties, including pneumonia detection in radiology, dermatological classification, and cardiac diagnostics (Bajwa et al., 2021).

3. Research methodology

Our study employs a systematic analysis to evaluate the economic implications of artificial intelligence integration in medical imaging, with a dual focus on market dynamics and value creation mechanisms. Our research examines both the quantifiable economic impact and the underlying factors driving this transformation.

The data collection process relies on comprehensive market surveys and analytical reports from established research organizations including McKinsey & Company, IDC, Grand View Research, and Allied Market Research. These sources provide validated market projections, growth rates, and economic indicators based on rigorous industry analysis and primary research methodologies. The medical findings and clinical impact assessments are derived from extensive meta-analyses and systematic reviews of peer-reviewed literature.

Our study focuses on the U.S. AI healthcare market, given that North America dominates the global market, accounting for 43% of revenue share in 2023 (Grand View Research, 2024). This dominance is attributed to advanced healthcare infrastructure and significant investment in healthcare technology.

4. Findings

The integration of AI in medical imaging represents a significant economic transformation in healthcare delivery. Our analysis reveals substantial market growth coupled with measurable improvements in operational efficiency and cost reduction through various mechanisms.

The AI medical imaging market demonstrates significant growth and economic potential. Current market valuations vary across research firms, with 2023 valuations ranging from $1.01 billion (Grand View Research, 2024) to $2.34 billion (Maximize Market Research, 2024). Projections indicate substantial growth, with expected valuations reaching between $11.76 billion to $29.8 billion by 2030-2033, representing a compound annual growth rate (CAGR) of 28.19% to 32.1% (Globe Newswire, 2024; Sumant, 2024).

The U.S. AI in Healthcare market demonstrates significant growth potential across three key components: software solutions, hardware, and services. As illustrated in Figure 1, the market value started at approximately $2 billion in 2020 and is projected to reach $9.7 billion by 2030, with a compound annual growth rate (CAGR) of 35.8% from 2024 to 2030 (Grand View Research, 2024). Software solutions represent the largest segment, showing consistent growth throughout the decade, while hardware and services components also display steady expansion. This upward trajectory reflects the increasing adoption of AI technologies in healthcare settings, with software solutions leading the digital transformation of the healthcare industry.

The economic returns from AI implementation in medical imaging demonstrate substantial value creation across multiple dimensions. Analysis of five-year performance metrics reveals a basic implementation ROI of 451%, which increases significantly to 791% when accounting for radiologist time savings (Bharadwaj et al, 2024).

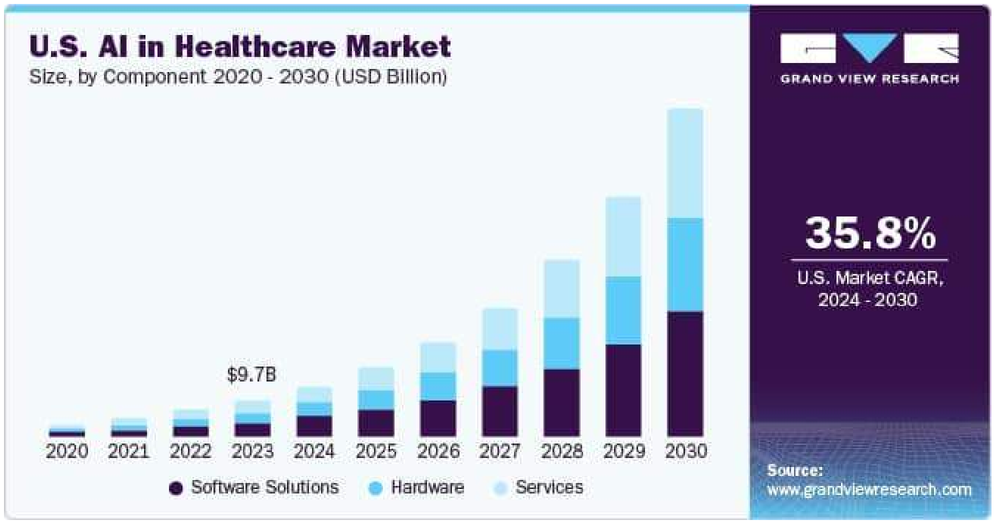
Revenue generation and cost reduction mechanisms manifest through several channels. Healthcare facilities report annual cost savings of approximately $1.2 million through reduced staff overtime and error mitigation. Additional revenue streams emerge from increased patient throughput, generating an average of $800,000 annually.

4.1 Mechanism

The adoption of AI in medical imaging has evolved into distinct implementation categories, each serving specific clinical needs. A couple of major AI applications emerge in the space of medical imaging, based on their role in the medical treatment, aiming both to optimize the workflow and improve patient outcomes:

- Triage AI applications
- Productivity AI applications
- Augmented AI applications

Figure no. 1 U.S. AI in Healthcare Market Size by Component (2020-2030)



Source: Grand View Research (2024)

Triage AI focuses on prioritizing urgent cases and managing workflow efficiency, with studies showing reduction in turnaround time from 11.2 days to 2.7 days for critical findings (Najjar, 2023). The integration of AI triage systems has demonstrated significant improvements in patient prioritization, with accuracy rates of 80.2% in predicting triage preparation (Tyler et al., 2024).

Productivity AI enhances operational efficiency through workflow optimization and resource management. Studies indicate that AI implementation can reduce MRI scan times from 60 to 15 minutes while maintaining diagnostic quality (Behl, 2024).

Augmented AI in medical imaging can be categorized into two primary functions: support applications and diagnostic assistance. Support applications enhance workflow efficiency by automating time-consuming tasks, such as organ and automated measurements of anatomical structures (Binariks, 2024). These tools allow medical professionals to focus on complex clinical decisions while maintaining accuracy. Diagnostic assistance applications serve as concurrent second readers, providing rapid analysis alongside human interpretation. This dual approach of support and diagnostic assistance creates a synergistic relationship between AI and healthcare providers, rather than replacing human expertise. Research shows that AI tools used as concurrent second readers can significantly improve diagnostic accuracy (Wenderott et al., 2024). In clinical trials, AI-assisted image-guided procedures consistently outperformed conventional methods, particularly beneficial with smaller targets and complex procedures (Christie, 2024).

Based of the metaanalysis by (Wenderott et al., 2024), the implementation of AI in medical imaging workflows demonstrates varying impacts on processing times across different tasks and implementation approaches. Analysis of 36 studies reveals that AI concurrent assistance reduced reading times by an average of 27.20%. The most significant improvements were observed in triage applications, where time reductions ranged from 73.08% to 96.29% for critical cases. Contouring tasks consistently showed substantial improvements, with time reductions between 30% and 50.80%. However, the impact of diagnostic AI varies by workflow type based on when the AI is introduced in the medical imaging workflow:

- **Triage Applications**: AI prioritizes cases before human reading, reducing turnaround time from 11.2 days to 2.7 days for critical findings
- **First Reader**: AI performs initial analysis before human review, demonstrating positive efficiency impacts across imaging modalities

- **Concurrent Reading**: AI analysis happens simultaneously with human interpretation, showing efficiency gains with reading time reductions up to 52.57%
- **Sequential Reading**: Radiologist completes interpretation first, followed by AI analysis, often increasing total processing time due to the step-by-step nature

While first reader and concurrent second reader implementations, in which AI is applied on the medical images from the beggining of the medical evaluation, generally showed positive results, whilst sequential reading sometimes led to increased times.

Table no. 1. Impact of AI Implementation on Various Medical Imaging Tasks.

Task Type	**Average Time Reduction**	**Range of Impact**
Reading Time	27.20%	-52.57% to +28.73%
Contouring	41.75%	-30.00% to -50.80%
Wait Time (Triage)	42.35%	-9.74% to -89.61%
Report Turnaround	18.02%	-22.22% to +19.94%

Note: Negative values indicate improvements (time reduction) and positive values indicate increased processing times.
Source: Author's contribution

5. Conclusions

The U.S. AI healthcare market demonstrates remarkable growth potential, projected to reach $187.7 billion by 2030 with a CAGR of 35.8% (2024-2030). Software solutions maintain market dominance, while hardware and services segments show steady expansion, indicating balanced ecosystem development. This sustained growth trajectory, particularly accelerating post-2025, reflects healthcare providers' increasing confidence in AI technologies and suggests their fundamental integration into modern medical practice. The market's evolution from approximately $2 billion in 2020 to its projected value in 2030 demonstrates AI's transition from an emerging technology to an essential component of healthcare delivery systems, with strong potential for continued innovation and value creation.

6. References

- Bajwa, J., Munir, U., Nori, A. and Williams, B., 2021. Artificial intelligence in healthcare: transforming the practice of medicine. *Future Healthcare Journal*, 8(2), pp. e188-e194. https://doi.org/10.7861/fhj.2021-0095
- Behl, N., 2024. Deep Resolve: Unrivaled Speed in MRI. *MAGNETOM Flash*, 89, pp. 2-11. [online] Available at: https://www.siemens-healthineers.com/nl-be/infrastructure-it/artificial-intelligence/ai-campaign/deep-resolve-in-mri [Accessed: 12 December 2024].
- Bharadwaj, P. et al. (2024). Unlocking the Value: Quantifying the Return on Investment of Hospital Artificial Intelligence. *Journal of the American College of Radiology*, 21(10), pp. 1677-1685. https://doi.org/10.1016/j.jacr.2024.02.034
- Christie, M., 2024. Augmented reality and radiology: visual enhancement or monopolized mirage. *BJR Open*, 6(1), https://doi.org/10.1093/bjro/tzae021
- Globe Newswire, 2024. AI in Medical Imaging Market Size Expected to Reach USD 11.76 Billion By 2033. *Press Release*, 24 June. [online] Available at: https://www.globenewswire.com/news-release/2024/06/24/2903185/0/en/AI-in-Medical-Imaging-Market-Size-Expected-to-Reach-USD-11-76-Billion-By-2033.html [Accessed: 12 December 2024].
- Grand View Research, 2024. U.S. AI in Healthcare Market Size, By Component 2020-2030. *Market Analysis Report*, January. [online] Available at: https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-healthcare-market [Accessed: 12 December 2024]
- IDC (Shirer, M.), 2024. Artificial Intelligence Will Contribute $19.9 Trillion to the Global Economy through 2030. *IDC Research Report*, 17 September. [online] Available at: https://www.idc.com/getdoc.jsp?containerId=prUS52600524 [Accessed: 12 December 2024]
- Kosteska, L., 2024. How AI Improves Medical Imaging Workflows. *Binariks, Industry Report*, 12 August. [online] Available at: https://binariks.com/blog/ai-in-medical-imaging-workflows/ [Accessed: 12 December 2024]

- McKinsey & Company, 2023. The economic potential of generative AI: The next productivity frontier. *McKinsey Digital Report*, 14 June. [online] Available at: https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier [Accessed: 12 December 2024]
- Najjar, R., 2023. Redefining radiology: a review of artificial intelligence integration in medical imaging. *Diagnostics*, 13(17), p.2760. https://doi.org/10.3390/diagnostics13172760
- Pinto-Coelho, L., 2023. How artificial intelligence is shaping medical imaging technology: A survey of innovations and applications. *Bioengineering*, 10(12), p.1435. https://doi.org/10.3390/bioengineering10121435
- Sahni, N. et al., 2024. The Potential Impact of Artificial Intelligence on Health Care Spending. *NBER*, 20 March. [online] Available at: https://www.nber.org/books-and-chapters/economics-artificial-intelligence-health-care-challenges/potential-impact-artificial-intelligence-health-care-spending [Accessed: 12 December 2024]
- Sumant, O. (Allied Market Research), 2024. AI in Healthcare Market by Offering, Algorithm, Application, and End user: Global Opportunity Analysis and Industry Forecast, 2020-2030. *Allied Market Research,* 16 December. [online] Available at: https://www.alliedmarketresearch.com/press-release/artificial-intelligence-in-healthcare-market.html [Accessed: 12 December 2024]
- Tyler, S. et al., 2024. Use of Artificial Intelligence in Triage in Hospital Emergency Departments: A Scoping Review. *Cureus*, 16(5). https://doi.org/10.7759/cureus.59906
- Wenderott, K., Krups, J., Zaruchas, F. and Weigl, M., 2024. Effects of artificial intelligence implementation on efficiency in medical imaging—a systematic literature review and meta-analysis. *npj Digital Medicine*, 7(1), p.265. https://doi.org/10.1038/s41746-024-01248-9
- Wolff, J., Pauling, J., Keck, A. and Baumbach, J., 2020. The economic impact of artificial intelligence in health care: systematic review. *Journal of Medical Internet Research*, 22(2), p.e16866. https://doi.org/10.2196/16866