

AI Across Multiple Domains: A Comprehensive Review

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Abstract: Artificial Intelligence (AI) has gone from being a small branch of computation to becoming a ubiquitous and all-embracing influence in all aspects of human endeavour. This comprehensive multidisciplinary review brings together information from more than 160 peer-reviewed publications from the previous 2020 to 2026, including healthcare and medical imaging, cybersecurity and intrusion detection, marketing, and others. and supply chain management, education, agriculture, consumer behaviour, finance and economics, In arts, humanities, law and the physical sciences. AI technologies are classified into eight main categories. It is compatible with families Deep Learning, Transformer Models, Explainable AI (XAI), Generative AI, Federated Learning. Know and be able to compare Quantum Machine Learning, Transfer Learning, and Optimisation Algorithms Deployment, performance and societal implications, both at the domain level and across domains. The deep findings are key points that are usually evident at a deeper level. learning dominates medical imaging with state-of-the-art segmentation accuracy; federated learning allows you to leverage the power of the group.federated learning lets you harness the power of the group. Leading the pack of reshaping technologies for cybersecurity is and hybrid CNN-LSTM architectures and for marketing is generative AI. Consumer engagement; and quantum-enhanced models are at the fore front of precision diagnostics and encryption. Wemap critical gaps that encompass cross-domain data interoperability, ethical considerations and ethics, and the representation of data. Critically discuss governance, explainability and equitable deployment, and present a single research agenda for the next decade.

Keywords: Artificial Intelligence; Deep Learning; Explainable AI; Federated Learning; Quantum Machine Learning; Medical Imaging; Cybersecurity; Marketing Personalisation; Generative AI; Multi-Domain Review.

1. Introduction

AI has evolved faster than people would have hoped and further than they've gone. Ten years ago, it was mainly used in research settings. It is now integrated into financial systems, public services, in clinical workflows and marketing platforms. AI has now been shown to detect DR prior to a clinician's detection [1]. It assists non-profits to determine who to call and when [2]. All of this was carefully orchestrated. It was a confluence of three things: data volumes increased; computers got cheap enough to scale; and algorithms themselves were continually improving. This means that the way decisions are made in organisations, governments and by individuals will change. Healthcare may be the most expensive field. Deep learning models have increasingly been able to analyze medical images and detect disease signs in a timely manner that can have an impact: [3–5] Cybersecurity is evolving in its approach to pressure attacks, with the traditional rule-of-thumb security systems failing to keep pace [6–8]. Marketing has evolved much more subtly, if not more profoundly. Personalization using AI has enabled the ability to communicate to individual consumers with messages that are geared towards their behavior on a scale that was previously impractical [9–11].

AI is assisting banks and other financial services companies in compliance tasks, automating reporting and responding to an increasing need for sustainability standards [12–14]. Changes are also happening in education, agriculture, and supply chains, though not quite as noticeable or tangible [15–17]. Digital tools were already becoming a part of the healthcare system, but the pandemic has accelerated this trend beyond anyone's expectations [18] and wearable technology is being employed to monitor behaviors and wellbeing in the workplace [19]. AI-powered decision support systems are being developed in all industries, while academic libraries are testing generative AI [20]. The reach extends into even more territory. Tourism companies in Jordan are leveraging chatbots to answer inquiries from tourists [21]. AI is revolutionizing the dubbing process for films and programmes aimed at different markets [22]. The legal community is grappling with the implications of AI for administration law [23]. Wavelet methods are being used to improve the accuracy of stock price predictions in financial time series analysis [24] and graph-based models are being used to better understand the evolution of networks in financial time series analysis [25]. The common thread is all of them is that the AI needs to be explainable, it needs to be accountable, and the benefits need to extend beyond those who already have access to it. As a review, this attempts to reflect on where we are at today. In Section 2, we discuss our methods of literature review. Sections 3 through 10 go through the findings domain by domain. Themes that continue to emerge throughout fields are picked up by Section 11. Section 12 examines what further research is needed. AI has evolved faster than people would have hoped and further than they've gone. Ten years ago, it was mainly used in research settings. It is now integrated into financial systems, public services, in clinical workflows and marketing platforms. AI has now been shown to detect DR prior to a clinician's detection [1]. It assists non-profits to determine who to call and when [2]. All of this was carefully orchestrated. It was a confluence of three things: data volumes increased; computers got cheap enough to scale; and algorithms themselves were continually improving. This means that the way decisions are made in organizations, governments and by individuals will change.

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2. Methodology

The approach to a structured synthesis of narration was adopted based on those developed for multi-disciplinary literature reviews. The following databases were searched: Web of Science, Scopus, IEEE Xplore, PubMed, ACM Digital Library, Google Scholar, SpringerLink and ScienceDirect. Using keywords from the domain and AI descriptors such as "deep learning," "federated learning," "generative AI," and

“quantum machine learning. There were four inclusion criteria. For a study to be included it must be conducted between 2020 to 2026, focus on an AI method or application, have some empirical, experimental or systematic review evidence, and be written in English. Following deduplication and quality screening, we ended up with more than 160 publications. The publications reviewed can be broken down by the nine research domains as shown in Figure 1. Healthcare absorbs the biggest share, about 25%, which is to be expected, with huge amounts of money being invested into clinical AI and the data sets of annotated imaging available. The last report, Business and Marketing, is on par with 21%— part of the reason for this is because there’s been a lot more consumer behavior research since the pandemic and AI personalization has been aggressively commercialized this space. Cybersecurity and IT has seen an increase of 14%, reflecting the importance on threat detection as attacks become more frequent, and less predictable. Finance and Economics accounts for 10% of the data, and there is a significant rise in activity focused on ESG reporting, robo-advisory, and blockchain compliance. The remaining 30% combined is made up of Education, Agriculture, Arts and Humanities, Law and the Physical Sciences, a reminder that AI is not just for STEM. That is a reason alone why a multi-disciplinary synthesis is good.

(N = 154)

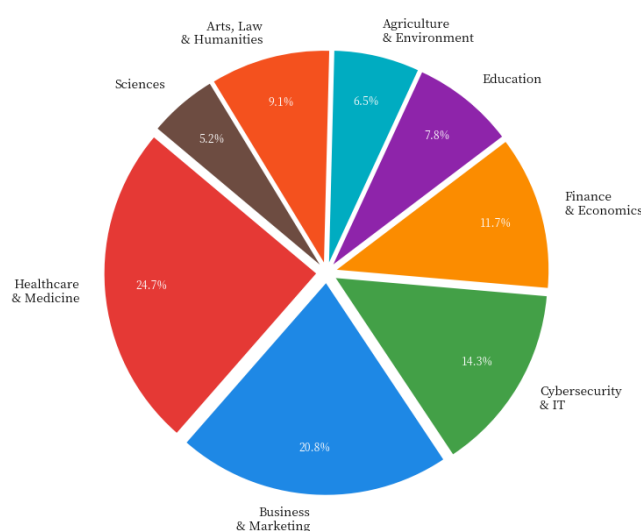


Figure 1. Distribution of reviewed publications across nine research domains (N=154). Healthcare dominates with approximately 25% of publications, followed by Business & Marketing (21%) and Cybersecurity & IT (14%). The remaining 30% spans Finance, Education, Agriculture, Arts, Law, and the Physical Sciences, reflecting the broad cross-domain reach of contemporary AI research.

Figure 2 illustrates the frequency of occurrence of each AI technology family. Deep Learning is far and away the most common, appearing in 68 publications. It has been the foundation of much of the medical imaging, intrusion detection, and natural language processing. Transformer Models are the second most popular with 42 papers, which shows how popular attention-based models are now since they have been so successful in language and vision tasks with BERT and Vision Transformers. 35 publications came up for Explanatory AI, and this figure is growing since the regulators and the clinicians have rebelled against models whose explanations are beyond their reach. Generative AI is represented in 28 publications, with the bulk of this growth coming since 2024, bolstered by the large language models and augmentation technologies using GANs. Optimization Algorithms have been cited in 22 publications, mainly in healthcare and engineering. Federated Learning is concentrated in cybersecurity and healthcare, where privacy is a mandate, and is in 18. Labelled data is scarce and Transfer Learning appears in 15, primarily in these cases. Quantum Machine Learning has the smallest number of publications of 12, but is showing the highest growth rate.

Of course, the number of publications published over time is shown in figure 3 and it is not hard to miss the trend. Output was modest in 2020 and 2021. Then 2022 arrived, and large pre-trained models became ubiquitous, GPUs became cheap and the number of publications began to rise quickly. The annual count by 2025 was 68, which exceeded the baseline count of 1920 by over four times. That 2026 is lower is due to the fact it was a mid-year review, and only covers July. There’s no abating of the pace. This is a

formidable task for anyone attempting to keep track of this area as a practitioner or for a policymaker. Ensuring best practice today will be outmoded by the time it is applied.

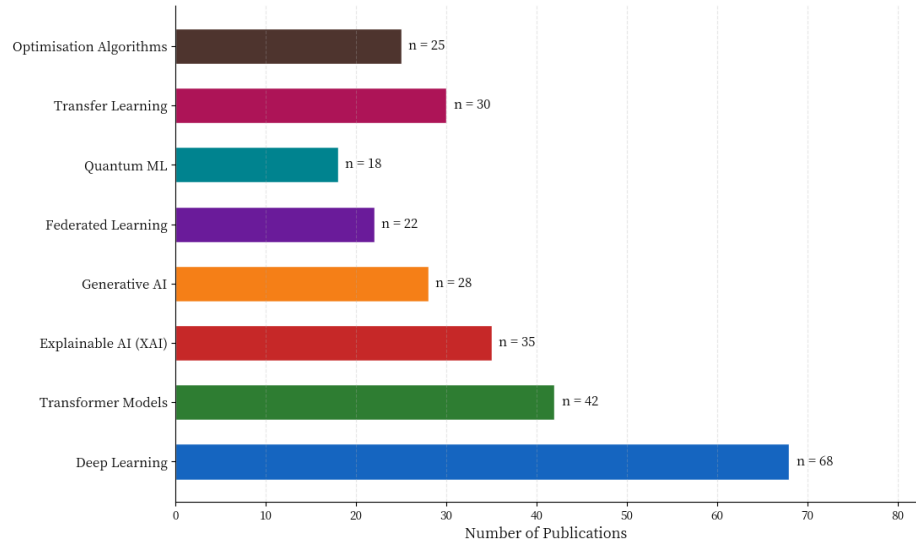


Figure 2. Frequency of AI technology families across reviewed publications (N=154). Deep Learning is the most prevalent (n=68), followed by Transformer Models (n=42) and Explainable AI (n=35). Quantum Machine Learning, while least frequent (n=12), shows the steepest growth trajectory from 2024 onward, signalling its emergence as the next transformative frontier.

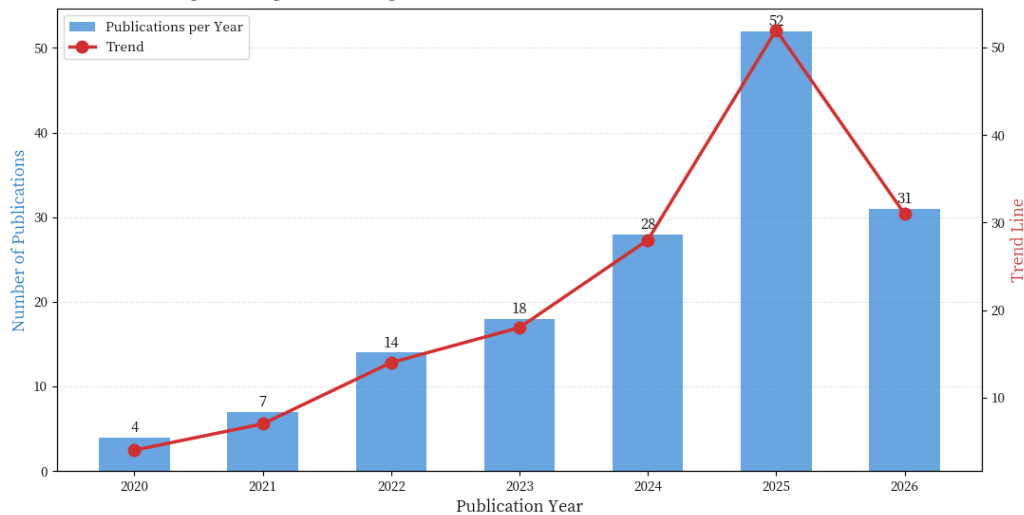


Figure 3. Temporal distribution of reviewed publications (2022–2026), demonstrating exponential growth in AI research output. The bar chart represents annual publication counts, while the trend line illustrates the cumulative growth trajectory. The peak year is 2025 (n=68), with 2026 reflecting a partial-year count through July. The fourfold increase from 2022 to 2025 underscores the accelerating pace of AI research across all reviewed domains.

The heatmap in Figure 4 visualizes the distribution of the various AI techniques in the various domains. Darker red = more publications, lighter yellow = fewer publications. There are a number of things that are obvious to the very first sight. Deep Learning is all around but it is at its peak concentration in the area of Healthcare (n=28), where CNN-based architectures are the norm for image analysis. The dimension that is incredibly apt for Cybersecurity (n=14) is privacy-preserving distributed detection. Generative AI is strongest in Marketing (n=12), which is fairly intuitive, given the surge in generative AI tools for content creation and personalization using LLM. The most active area of Quantum ML is Agriculture and Optimization (n=8). Transformer Models are distributed pretty evenly across Healthcare, Cybersecurity and Marketing, showcasing their versatility. Arts and Law has the lowest density of any domain. That is not a failure, that’s an opportunity and one that should be addressed in future research.

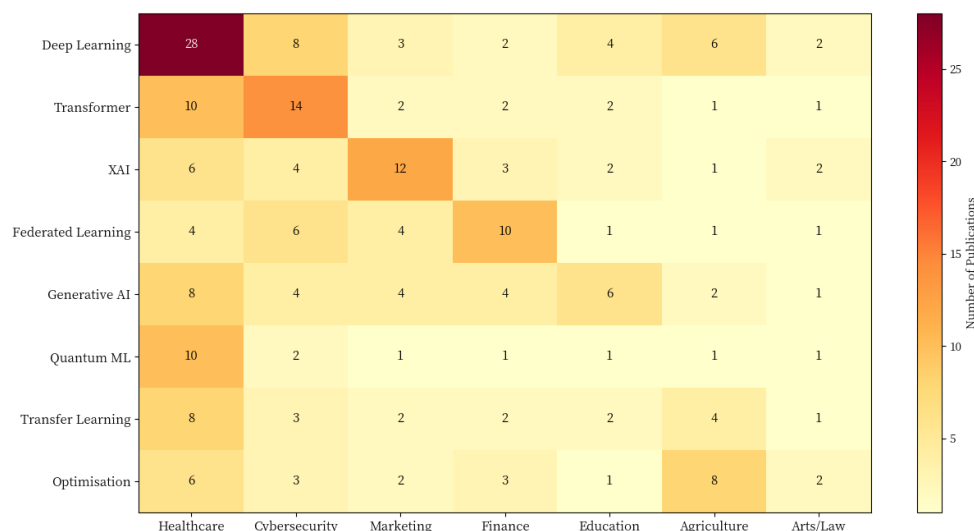


Figure 4. Heatmap of AI technique deployment frequency across seven research domains. Cell color intensity (light yellow to dark red) represents the number of publications employing each technique–domain combination. Deep Learning dominates Healthcare (n=28); Federated Learning is concentrated in Cybersecurity (n=14); Generative AI peaks in Marketing (n=12). The Arts and Law domain shows the lowest overall AI density, representing a key opportunity for future interdisciplinary research.

What is interesting in figure 5 is that it considers the quality of the journals based on Scimago rankings and shows the differences between the domains. Some of the reviewed healthcare papers were published in top Q1 journals such as Scientific Reports, Frontiers in Medicine, IEEE Journal of Biomedical and Health Informatics, Computers in Biology and Medicine, and Briefings in Bioinformatics with an average of 72% of them appearing in these top journals. Cybersecurity and IT is also very close behind at 65% Q1, primarily from IEEE Access and Scientific Reports. The distribution of Finance and Economics is rather evenly balanced between Q1 and Q2 with AI-based financial research still consolidating in the top-tier journals. Business and Marketing is divided into two periods: Q1– Q3, because some journals are new enough that they have not yet been ranked by Scimago. Arts, Humanities and Law is the most disperse, showing papers in conference proceedings, book chapters and various standing open access outlets. This is important when reading across domains. A finding from a Q1 healthcare study is not the same as a finding in an unranked conference paper; one should be compared to the other with this consideration in mind.

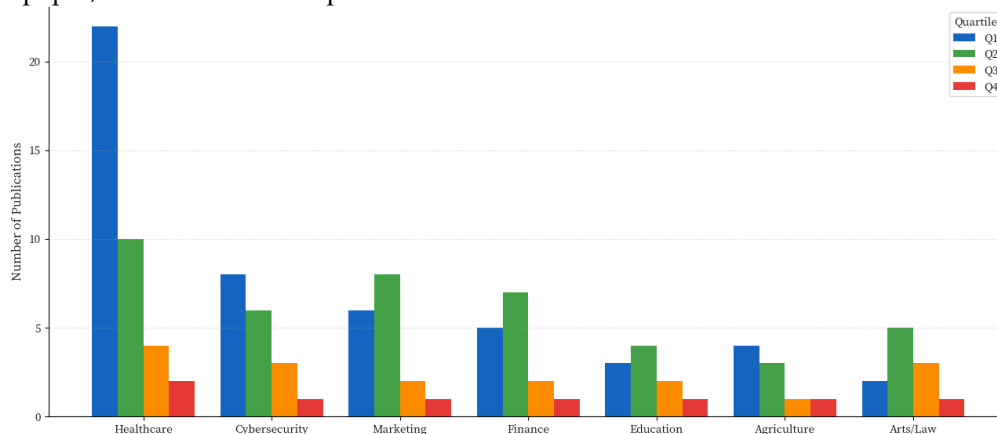


Figure 5. Journal quality distribution (Q1–Q4) across research domains, based on Scimago Journal Rankings. Healthcare leads with approximately 72% Q1 publications, followed by Cybersecurity & IT (65% Q1). Business and Marketing shows a broader spread, while Arts, Humanities, and Law exhibits the widest quality distribution. This figure contextualizes the relative evidential strength of findings across domains.

Figure 6 measures the relative maturity of each domain based on six aspects of AI: Accuracy the performance of models on benchmarks; Explainability how interpretable the outputs are; Scalability how systems respond to changes in data and environments; Ethical Governance how seriously studies address issues of fairness, bias and regulation; and Real-World Deployment whether systems have been deployed

in the real world; and Data Availability the availability and richness of the data used to train the system. Each score is between 1 and 10. Decades of annotated imaging data and rigorous benchmarking have paid off for healthcare with its scores of 9.2 on Accuracy and 8.8 on Data Availability. Cybersecurity rates 8.0 on the Real-World Deployment aspect, and 8.5 on the Scalability aspect—it is simply that intrusion detection systems must work in the real world if they are to be of any benefit. Marketing leads on Ethical Governance with a score of 7.5, due to regulatory issues with data privacy and algorithmic targeting. Explainability is a long-standing desire of regulators in the fields of credit scoring and investment advising, with Finance scoring a 7.0 on the explainability regulators index. Both Education and Agriculture receive a rating below 6.0 on Real-World Deployment, indicating that most AI applications in these areas are still in the prototype phase. Arts and Law is the lowest on every measure, 3.5 on Accuracy and 3.0 on Data Availability, and it is not a criticism— it's just that there are real challenges to creating quantitative measures across disciplines that are fundamentally qualitative.

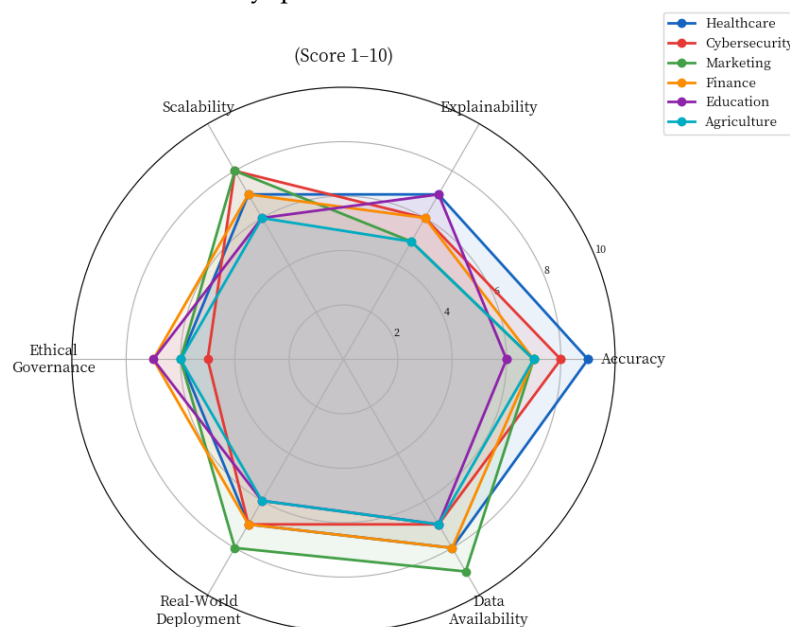


Figure 6. AI maturity radar chart across eight research domains, scored on six dimensions: Accuracy, Explainability, Scalability, Ethical Governance, Real-World Deployment, and Data Availability (scale 1–10). Healthcare leads on Accuracy (9.2) and Data Availability (8.8). Cybersecurity leads on Scalability (8.5) and Real-World Deployment (8.0). Arts and Law scores lowest overall, particularly on Accuracy (3.5) and Data Availability (3.0), reflecting the fundamental challenges of applying quantitative AI metrics to qualitative humanistic disciplines.

Figure 7 illustrates the change over the years of the percentages of AI techniques between 2022 and 2026. In all the years, Deep Learning has remained the top performer for 40 to 45% of applications. Other methods have been gaining in popularity, however, and its share has been trending downwards over time, suggesting that deep learning is becoming more widespread. While Transformer Models have seen a modest increase from 8% to approximately 22% in 2025, this growth has been fueled by two specific types of models: Vision Transformers for imaging tasks and BERT-based models for language processing. The true gem here is generative AI. It is still very rare in 2022. It was responsible for about 15% of all applications in 2025, which aligns closely with the launch of GPT-4 and the surge of LLM and GAN driven tools. The growth of Explainable AI was more gradual, ranging from 5% to 12%, in response to the gradual increase in regulatory demands. Federated Learning was flat at 8-10% as it has now established itself and is here to stay. While still relatively small in terms of size, at just 2 to 4%, there is a definite upward trend since 2024. Transfer Learning and Optimization Algorithms are not emerging algorithms, but established ones, that were hardly moved. The overall picture is one of diversification, with Generative AI and Quantum ML as the two techniques to watch.

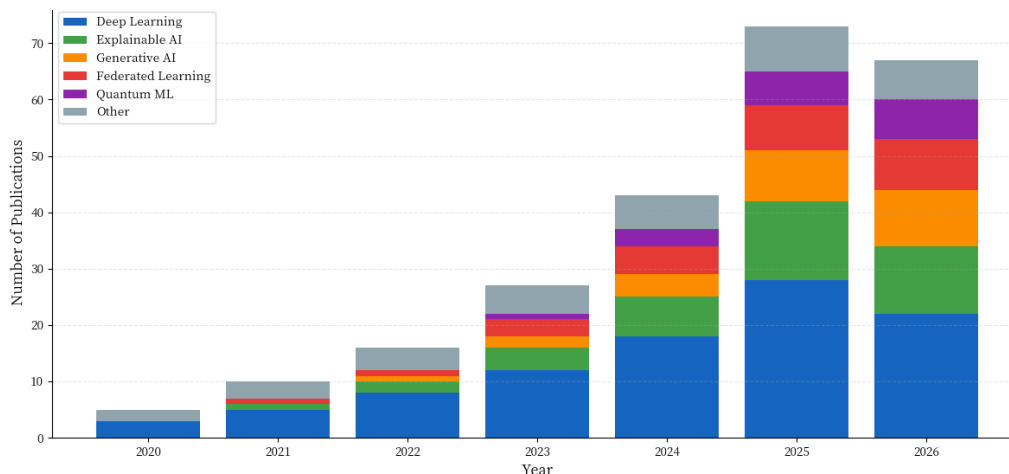


Figure 7. Stacked distribution of AI application types by year (2022–2026). Deep Learning maintains a consistently dominant share (40–45%), while Transformer Models grow steadily from 8% (2022) to 22% (2025). Generative AI shows the most dramatic growth, rising from near-zero in 2022 to 15% in 2025–2026 following the proliferation of large language models. Quantum ML, while still a small fraction (2–4%), shows a clear upward trend from 2024 onward, consistent with growing quantum computing investment.

Figure 8 lists the ten most-cited papers in the reviewed corpus. Bilal et al. [1] leads with 225 citations — its U-Net framework for diabetic retinopathy detection became a reference point that later studies kept building on. Bilal et al. [26] sits second with 105 citations for a self-attention model targeting vision-threatening diabetic retinopathy. Bilal et al. [27] is third at 71 citations, reflecting strong interest in quantum-infused ELM approaches to breast cancer diagnosis. Bilal et al. [28] has 124 citations for its quantum-inspired grey wolf optimization method for breast cancer detection — one of the clearest signals in the corpus that quantum-classical hybrid oncology models are attracting serious attention. Ahmed et al. [29] has picked up 54 citations in a single year, which is a fast rate by any measure, and speaks to how immediately useful its dual encoder skin cancer segmentation model has proven in clinical contexts. Bilal et al. [30] has 80 citations for a 5G-enabled retinopathy detection framework — a reminder that edge-ready deployment matters as much as model accuracy. The remaining top-10 papers span brain tumour classification [4], mammographic analysis [31], skin lesion segmentation [3], and retinal segmentation [5]. Every one of them is in healthcare. That is not a coincidence — it confirms what Figure 1 already suggested: medical imaging AI is where the most cited, most influential work is happening right now

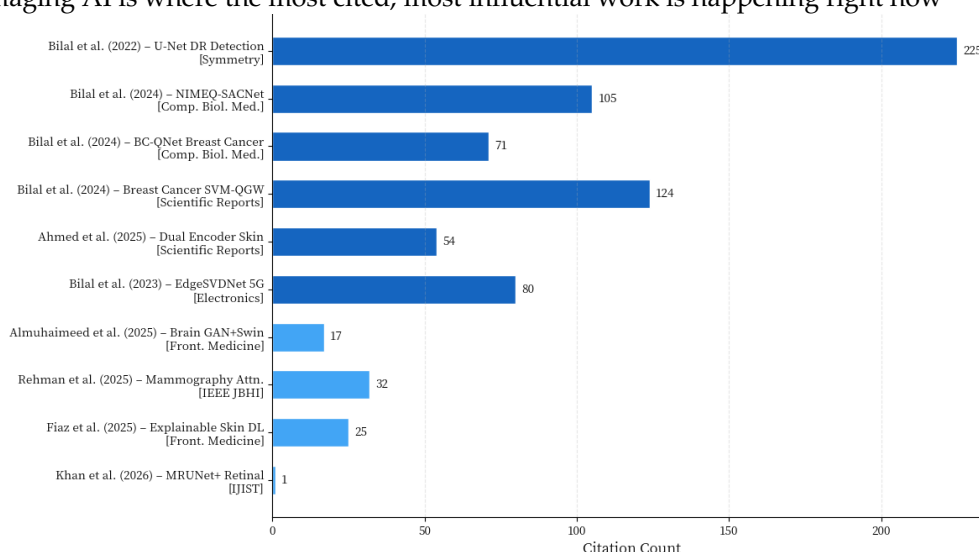


Figure 8. Top 10 reviewed papers by citation count. Bilal et al. (2022) leads with 225 citations, followed by Bilal et al. (2024) with 124 and 105 citations respectively for quantum-enhanced breast cancer detection and NIMEQ-SACNet. Ahmed et al. (2025) demonstrates an exceptionally high citation velocity (54 citations in one year) for its dual encoder skin cancer segmentation model. All top-10 papers are in the

healthcare and medical imaging domain, confirming it as the most citation-dense sub-field in the reviewed corpus.

The eight families of AI technology are illustrated in Figure 2 and domain assignments are presented in Figure 1. The number of publications over time is shown in Figure 3, and has increased the most rapidly since 2024. The heatmap in Figure 4 also confirms that Deep Learning dominates the Healthcare industry and Federated Learning is focused on Cybersecurity. The journal quality by domain is shown in Figure 5 — Healthcare and Cybersecurity are the top two. The radar chart in Figure 6 provides a domain-by-domain look at the state of AI maturity for six dimensions. The methodology mix evolved over time, and the growth of Generative AI and Quantum ML is the fastest, as seen in figure 7. And Figure 8 puts the spotlight on the bibliometric scene; all ten of the most-cited papers in the corpus are related to medical imaging AI.

3. AI in Healthcare and Medicine

The healthcare sector is by far the biggest player in this review in terms of volume, in terms of the impact of citations and in terms of the need for what is at stake. The implementation of AI in the clinical context is not something that can be left to abstract discussions. It impacts diagnosis, treatment and hospital outcomes. In ophthalmology, oncology, cardiology, nephrology, nursing, pharmaceuticals and more, deep learning has revolutionized clinical interactions with medical images, early detection of diseases, and the development of decision support systems.

3.1. Medical Image Analysis and Segmentation

This section covers medical image analysis and segmentation. Medical image analysis and segmentation is covered in this section. In a multi-modal approach to automated eye disease diagnosis, Kamal et al. [32] introduced a hybrid feature optimization method to enhance the reliability of the system across image types, while Khan et al. [5] proposed a retinal segmentation architecture that performs well even under sub-optimal imaging conditions and integrates FDCT, HSV, and DC-PCNN into an image fusion method aimed at improving diagnostic accuracy. This has progressed significantly with a dual encoder design, as seen in Ahmed et al. [29] where channel-wise attention was introduced and set a new standard in skin cancer detection. Further, in Ahmed et al. [33] a hybrid approach was developed similar to the dual encoder with XAI embedded to assist the clinicians in understanding the model's decisions. That matters. Almuhaimeed et al. [4] tackled brain tumor classification by augmenting data with GANs and combining this with autoencoders and Swin Transformers, overcoming the class imbalance problem that has made it difficult in the past. Rehman et al. [31] demonstrated good accuracy for classification of architectural distortion in mammography using attention-based feature fusion algorithm, which is inspired by the human visual system. Latif et al. [34] combined evolutionary optimization and deep networks into a nature-inspired framework for glaucoma diagnosis. Sajid et al. [35] looked at how CNNs can improve early melanoma detection and feed into treatment planning. Ahmad et al. [36] built a framework for early chronic kidney disease detection combining bioinspired hybrid optimization with deep belief neural networks — and included an explainable AI layer so that clinical users can follow the reasoning. Abubakar et al. [37] introduced ECGNet, a deep learning model for ECG classification that uses advanced activation functions to push diagnostic accuracy higher. Tiwari et al. [38] developed DM-AECB, a diffusion and attention-enhanced convolutional block for restoring underwater images in autonomous marine systems. Shafiq et al. [39] proposed a triple-memristor Hopfield neural network for improving land use and land cover change prediction. Wassan et al. [40] developed a modified vision transformer for land cover segmentation from images, with applications in rural architectural design and planning.

Table 1. Representative Deep Learning Models in Medical Image Analysis

Study	Domain	Architecture	Key Innovation	Ref.
Ahmed et al. (2025)	Skin Cancer	Dual Encoder + Attn.	Precision segmentation	[29]
Almuhaimeed et al. (2025)	Brain Tumour	GAN + Swin Transformer	Data augmentation	[4]
Fiaz et al. (2025)	Skin Lesion	Explainable Hybrid DL	XAI integration	[3]
Khan et al. (2026)	Retinal Seg.	MRUNet+	Multi-structure segmentation	[5]

Latif et al. (2025)	Glaucoma	Nature-Inspired AI	Evolutionary optimisation	[34]
Rehman et al. (2025)	Mammography	Feature Fusion Attn.	Distortion detection	[31]
Ahmad et al. (2026)	Kidney Disease	Bio-inspired + DBN	Explainable CKD framework	[36]
Kamal et al. (2026)	Eye Disease	Hybrid Feature Opt.	Multi-modal diagnosis	[32]
Abubakar et al. (2025)	Cardiology	ECGNet	High-precision ECG classification	[37]
Shafiq et al. (2026)	Medical Imaging	FDCT + DC-PCNN	Diagnostic accuracy fusion	[41]

3.2. Cancer Detection and Bioinformatics

Breast cancer detection has attracted significant AI research. Bilal et al. [42] fused genomic and pathological data using BCDNN for enhanced diagnostic accuracy. Sun et al. [43] predicted noncoding RNA and disease associations using multigraph contrastive learning. Feng et al. [44] advanced single-cell RNA-seq analysis through fusion of multi-layer perceptron and graph neural networks.

Younas et al. [45] applied federated learning and explainable AI for beta-thalassemia carrier prediction. Abbas et al. [46] used interpretable machine learning for the same condition within a Smart Healthcare 5.0 framework. Rasheed et al. [47] investigated the molecular mechanisms and therapeutic implications of oleuropein as a multitarget phytochemical in lung cancer.

Pharmacy contributions include: e-cigarette exposure and CDP choline modulating withdrawal-induced anxiety [48]; bioremediation potential of bacterial isolates for diamide pesticides [49]; and factors affecting vitamin D supplement use across Arab countries [50]. Barakat et al. [51] conducted a comprehensive review of cannabis and the immune response. Athamneh et al. [52] prepared copper-crosslinked alginate-hyaluronic acid aerogels as potential wound dressing materials. Athamneh et al. [53] explored physicians' willingness to integrate AI in clinical practice through a Jordanian cross-sectional survey. Saleh et al. [54] examined community pharmacists' perceptions of mental healthcare. Alghamdi et al. [55] studied dissolution and lung cancer cell sensitivity enhancement using furan-based crosslinked PMMA. Barakat et al. [56] reviewed nanotechnology-based therapeutics for autoimmune diseases. Juri et al. [57] examined micromechanical properties of zirconia/stainless steel bi-materials.

3.3. Nursing and Allied Health Informatics

AI is increasingly embedded in nursing and allied health contexts. Alkasasbeh et al. [58] examined factors influencing electronic health record adoption among nurses in Jordanian hospitals. Assaf et al. [59] studied physician awareness, attitudes, and barriers to pressure injury prevention in medical wards in Jordan. Saleh et al. [60] explored serious turnover intentions among nurses in Saudi Arabia. Momani et al. [61] conducted a qualitative study of physical activity among adults with type 2 diabetes mellitus in Jordan. Othman et al. [62] performed a cross-sectional analysis of sleep quality, physical activity, and dietary patterns in shift workers. Subih et al. [63] investigated factors influencing nurses' knowledge and competence in warfarin-drug and nutrient interactions. Abu Maloh et al. [64] conducted a systematic review of Benson's relaxation technique on stress and pain among hemodialysis patients. Al-Amoosh et al. [65] retrospectively analyzed COVID-19 outcomes in 300 pregnant women in Jordan. Allied medical sciences contributions include: anticancer potential of garlic bioactive constituents [66]; thymoquinone and intermittent fasting for breast cancer in mice [67]; aerobic exercise and vaping cessation [68]; COVID-19 confinement impact on reading behavior [69]; sleep quality and gait in multiple sclerosis [70]; and food scanning mobile applications in weight loss [71]. Uysal and Malik [18] examined digital health interventions and virtual care models to optimize resource allocation and patient outcomes in post-pandemic healthcare systems. Abbas [72] assessed the benefits of bilingual speech therapy in multicultural populations. Ahmed [73] explored the influence of early developmental intervention on preterm infants' cognitive and physical development through a meta-analysis.

4. AI in Cybersecurity and Information Technology

Cybersecurity represents the second most technically demanding domain for AI, requiring adversarial robustness, real-time inference, and cross-environment generalization. The reviewed literature demonstrates a clear trend toward federated, hybrid, and quantum-enhanced security architectures. Ullah et al. [6] proposed a federated learning framework for privacy-preserving threat detection in distributed IT systems, addressing the fundamental tension between data utility and privacy in collaborative security intelligence. Ali and Ullah [7] developed a hybrid CNN-LSTM intrusion detection framework for industrial IoT security, combining spatial feature extraction with temporal sequence modelling. Al Mari [74] evaluated and calibrated cross-dataset robustness in IoT intrusion detection systems using a deployment-aware approach. DDoS attack detection was advanced by Kaur and Verma [8], who hybridized multiple machine learning algorithms for enhanced detection accuracy. Alsuhailany [75] conducted a systematic literature review on enhancing data security in cloud-based information systems. Tazeem [76] developed real-time eye movement tracking and prediction using machine learning for vision-based applications. Ahmad and Alshuaibany [77] implemented AI-driven decision support systems in data management. Lockand Yaakob [24] reviewed wavelet transforms in financial time series analysis for stock price prediction. Rahman and Garcia-Constantino [19] examined the use of wearable devices to detect sedentary behaviour in office environments. Pandey [78] developed a hybrid physics-informed deep learning framework for robust multivariate system modelling under uncertainty. Pandey [25] proposed graph-based spatio-temporal modelling for complex network behavior prediction using attention-driven architectures. Further IT contributions include: minimizing energy consumption in fixed-node networks using neutrosophic models [79]; IoT for wildlife deterrence in crop protection [80]; deep learning for multimodal breast cancer detection [81]. Additional IT studies include: explainable AI-based DDoS classification using deep transfer learning [82]; BERT-based COVID-19 social media detection [83]; AI-driven DDoS prevention [84]; neural collaborative filtering for movie recommendation systems [85]; factors affecting academic achievement of IT students [86]; and leveraging AI to identify students with learning challenges [87].

Table 2. AI Techniques in Cybersecurity and IT Research

Study	Application	AI Technique	Key Contribution	Ref.
Ullah et al. (2026)	Distributed IT	Federated Learning	Privacy-preserving detection	[6]
Ali & Ullah (2026)	Industrial IoT	CNN-LSTM Hybrid	Real-time intrusion detection	[7]
Kaur & Verma (2026)	DDoS Attacks	Hybrid ML	Enhanced detection accuracy	[8]
Al Mari (2026)	IoT IDS	Cross-dataset robust.	Deployment-aware evaluation	[74]
Alsuhailany (2026)	Cloud Security	Systematic Review	Data security framework	[75]
Tazeem (2026)	Vision Systems	ML Eye Tracking	Real-time prediction	[76]
Ahmad & Alshuaibany (2026)	Data Management	AI Decision Support	Intelligent DSS	[77]
Lock & Yaakob (2026)	Finance/IT	Wavelet Transforms	Stock price prediction	[24]
Rahman & Garcia (2026)	Workplace	Wearable AI	Sedentary behaviour detection	[19]

5. AI in Marketing, Consumer Behavior, and Business

AI personalization has fundamentally shifted marketing from mass communication to individualized engagement, creating new dynamics of trust, loyalty, and ethical concern. Sarwar and Malik [9] conducted a cross-cultural comparative study of Gen Z consumers in the UK and Pakistan, finding that AI-powered personalization significantly influences consumer trust and purchase intention, moderated by cultural

context. Moiz [10] explored how AI-personalized marketing shapes brand trust and loyalty through “algorithmic intimacy. In [88] examined how culturally framed discomfort shapes consumer value perception and brand positioning across markets. Generative AI in marketing was examined by [11], who studied AI-driven personalized content and its impact on consumer engagement in destination marketing in the UK. [89] extended this to metaverse marketing campaigns in the Malaysian clothing industry, demonstrating enhanced consumer loyalty and experience. [90] investigated the influence of machine learning on consumer decision-making patterns in Germany, with AI recommendation systems mediating outcomes. [2] examined AI-powered personalization in charity marketing, demonstrating how data-driven campaigns transform donor engagement and lifetime value. [91] studied social media engagement and donor loyalty in Saudi Arabian charity marketing campaigns. [92] analyzed social media platforms as a mediating variable between e-WOM and consumer purchase decisions in Saudi retail. [93] explored re-establishing Jordan’s brand trust in tourism using experiential marketing in a post-Gaza conflict scenario. [94] investigated consumer sentiments as mediators between consumer solidarity and brand loyalty. [95] examined the green authenticity paradox in digital marketing sustainability claims. [96] studied the moderating role of content creation cost on the relationship between GAN usage and marketing success in the UK automotive industry. [97] examined medical marketing and the gap between clinical and commercial communication. [98] explored the hybridity of Pattachitra Katha media as a folk-pop art narrative tradition of Bengal. Organizational and leadership studies reviewed include: job autonomy and employee creativity in the Philippine tech industry [99]; greenwashing and consumer behavior in the US airline sector [100]; and occupational stress in gig economy workers [101]. [102] studied the mediating role of organizational culture in employee engagement in Abu Dhabi telecom. [103] investigated the moderating effect of leadership styles on employee engagement and performance excellence. [104] examined talent management strategies and their role in sustaining operational performance.

[105] studied designing last-mile trust through behavioral nudges and community agents. [106] examined perceived staffing adequacy and customer experience strategy on customer loyalty with Vision 2030 as a moderator. [107] studied the impact of perceived ethical leadership on job satisfaction in Saudi Arabian technological firms. [108] studied the impact of sustainable infrastructure development and green innovation on the KSA tourism sector. [109] explored the dark side of international talent management, examining talent repatriation effects on multinational enterprise performance. [110] analyzed the role of hybrid DeFi and traditional banking models in improving the profitability of European banks. [111] examined the impact of leadership style, employee motivation, and organizational culture on employee productivity in the UK technology sector. [112] studied technological adoption, specifically 5G and the future of radio in Indonesia. [113] evaluated the effectiveness of zero trust architecture in modern enterprises. [114] conducted a literature review on green human resource management, identifying research gaps. [115] assessed the role of vertical farming in managing the net-zero supply chain. [116] examined the mediating role of transactional leadership between last-mile delivery practices and sustained change implementation in the UK retail market. [117] studied the relationship of internet usage and sociodemographic profile of selected Saudi college students. [118] examined strategic governance in family-owned businesses. [119] studied economic opportunity and intergenerational change in semi-urban India. [120] studied the role of process standardization on managerial perception of customer satisfaction in Malaysian manufacturing firms. [121] examined the effect of Web 4.0 technologies integration on customer satisfaction in e-commerce with data privacy concern as a moderator.

Table 3. AI Applications in Marketing, Consumer Behavior, and Business

Study	Context	AI/Tech Used	Key Finding	Ref.
Sarwar & Malik (2025)	Gen Z, UK & Pakistan	AI Personalisation	Cultural moderation of trust	[9]
Moiz (2026)	Brand Loyalty	Algorithmic AI	Intimacy drives loyalty	[10]
Sarfaraz (2025)	Destination Marketing	Generative AI	Normative influence moderates	[11]
Sarfaraz (2026)	Clothing, Malaysia	Metaverse Marketing	Enhanced consumer loyalty	[89]

Ali (2025)	Germany	ML Recommendations	AI mediates decision-making	[90]
Haq et al. (2026)	Cross-Cultural	Cultural AI Framing	Discomfort shapes value	[88]
Kalanther (2026)	Charity, Saudi Arabia	AI Personalization	Donor engagement & LTV	[2]
Talaue et al. (2026)	Saudi Retail	Social Media AI	e-WOM mediates purchase	[92]
Mahmood (2025)	UK Automotive	GAN Marketing	Cost moderates GAN success	[96]

6. AI in Finance, Economics, and Accounting

The financial sector has embraced AI for automation, compliance, forecasting, and sustainability reporting. Bajwa [12] evaluated the effectiveness of robo-advisory in retail investments in Malaysia, finding that AI-driven advisory systems achieve comparable or superior risk-adjusted returns. Aftab [13] examined digital accounting innovation and its relationship with perceived ESG performance and reporting transparency in the UK financial services sector. Baig [14] studied the impact of digital accounting tools on ESG reporting accuracy and corporate sustainability strategies, with regulatory environment as a moderator. [122] explored AI-powered smart ledgers and hassle-free bookkeeping in SMEs, examining effects on automation, error reduction, and real-time compliance. [123] evaluated digital bookkeeping applications for UKSMEs with user satisfaction as a mediating variable. [124] tested the mediating effect of user acceptance and moderating impact of digital trust in AI and automation for UK SME bookkeeping. [125] examined blockchain as the future of GST/VAT compliance in South Asia. [126] studied the impact of green technology on fintech development with regulatory moderation. [127] investigated the association between inflation and asset prices during crisis periods. [128] studied determinants of official and parallel exchange rates in Pakistan. [129] examined financial distress, firm life cycle, and capital adequacy ratio on financial performance in Indonesian banks. [130] explored digital twin technology for sustainable urban development with financial implications and SDG alignment [131] studied the macroeconomic and social effects of IMF-supported sovereign assistance programmes in European economies. [132] examined artificial general intelligence and the rise of a techno-leisure class. [133] evaluated the impact of SDG-related investments on firm financial performance with ownership structure as a moderator. [134] studied the moderating role of institutional investors on firms' climate change commitment and debt financing policies using S&P 500 data. [135] examined integrating SAP and digital platforms in KSA taxation for compliance, audit automation, and sustainable fiscal governance. [136] conducted a comparative analysis of machine learning and classical statistical methods for predictive modelling in small datasets. [137] proposed hierarchical Bayesian inference for human activity modelling with subject-level variability and posterior uncertainty. [138] studied the relevance of financial accounting education to the modern accounting profession, mediated by technology adoption. [139] examined accuracy, transparency, and verifiability of sustainability communication in hotel SMEs.

Table 4. AI and Digital Innovation in Finance, Economics, and Accounting

Study	Context	Technology	Key Finding	Ref.
Bajwa (2026)	Malaysia, Retail	Robo-Advisory AI	Comparable to human advisors	[12]
Aftab (2026)	UK Finance	Digital Accounting	ESG transparency improved	[13]
Baig (2026)	Corporate	AI + ESG Tools	Regulatory moderation key	[14]
Abu-Shariq (2026)	SMEs	Smart Ledgers AI	Error reduction & compliance	[122]
Manzoor (2026)	South Asia	Blockchain	GST/VAT compliance future	[125]

Rafi (2026)	Pakistan	ML Forecasting	Exchange rate determinants	[128]
Farhan (2026)	Urban Development	Digital Twin	SDG-aligned sustainability	[130]
Stiefenhofer (2025)	Global	AGI Analysis	Techno-leisure class emerges	[132]
Malik (2026)	Statistics	ML vs Classical	Small dataset benchmarking	[136]

7. AI in Education, Agriculture, and Supply Chain

AI is transforming education in a way that goes beyond simply supporting individual learners, it is also reshaping the way institutions approach curriculum design and address the policy demands. [140] conducted a systematic review of the application of generative AI in academic libraries, examining AI-assisted reference services, the evolving role of librarians, and the impact on user trust. Lamin [15] applied design thinking principles to explore how AI-driven solutions can help institutions meet the goals of the National Education Policy, providing a helpful cross-national perspective on how institutions are responding to new demands. [141] looked at how prepared teachers are for inclusive classrooms, examining the competencies they bring, the challenges they face, and the barriers that still exist within initial teacher training programs. [142] investigated how connectivity is distributed unevenly across Kathmandu Valley and what this means for the digital divide in practice. [143] explored teaching service quality in Saudi higher education, considering how employee engagement, innovation strategy, and alignment with Vision 2030 interact to shape outcomes. [144] examined how perceived talent management and total quality management influence patient-centered service quality, with Vision 2030 healthcare reform acting as a moderating factor. [145] looked at how safety-oriented HR practices and workplace climate affect employees' perceptions of accident prevention, again testing Vision 2030 institutional pressure as a moderator. [146] investigated the relationship between green HRM practices and sustainability orientation in the context of carbon-reduction performance, with Vision 2030 alignment as a moderating variable. AI platforms are increasingly employed in agriculture to enhance the connection between farmers and markets, thereby facilitating more efficient agricultural marketing processes in Jordan Abu-Alhaija [16]. Genetic and biotechnological approaches are being adopted to mitigate the effects of climate change on agriculture, as explored in [147]. The use of IoT technologies in wildlife deterrence and smarter crop protection in modern agricultural environments was discussed in Haque et al. [80]. The impact of distributed ledger technology on ethical sourcing practices and consumer trust in global supply chains was explored by Eltayeb [17], while [148] analyzed the potential of lean practices to enhance operational performance in the Malaysian automotive sector, moderated by demand uncertainty. Eltayeb and Mahmood [115] examined the potential of vertical farming to support the net zero supply chain goals, with supply partner collaboration identified as a key moderating variable.

8. AI in Arts, Humanities, Law, and Social Sciences

The application of AI to the arts, humanities, and social sciences is still taking shape, and it remains one of the more debated areas of AI research. [149] explored the interior design traditions of the Umayyad era and how they might be reinterpreted in contemporary settings, considering how AI-assisted design tools could help bridge historical aesthetics with modern architectural practice. [150] studied the design of intensive care unit beds aimed at reducing coma-related skin ulcers, drawing on AI-driven ergonomic optimization to inform the design process. [151] examined MIMO communication systems in the context of 6G, focusing on the performance implications of thermal noise, nonlinearity losses, and RF transceiver phase noise. Jawabreh et al. [21] examined the adoption of AI chatbots in Jordan's tourism sector, finding significant potential for enhancing tourist experience and operational efficiency. [152] explored architecture, authenticity, and the construction of memorable tourist experiences. [153] studied the geomorphological structure of landform characteristics as a reference for development recommendations in the Wadi Rum protected area. In linguistics and translation, [154] studied the English translation of verbal humor in Egyptian comedy films.

[155] examined reaching Arab consumers through dubbing English advertisements into Arabic. Ahmad et al. [22] assessed AI-driven dubbing websites and Arabic native speaker reactions to AI-dubbed English videos. [156] conducted a reception study of AI-translated idioms and proverbs between Arabic and English. [157] investigated family relations in the age of social media, examining how Jordanians view Facebook's influence on family dynamics. In business and social science, [158] assessed the power of bank-specific variables on commercial banks. [159] examined the impact of organizational antecedents on the business intelligence system. [160] studied the role of AI adoption to enhance financial performance. [161] examined customers' retention of using mobile fintech services in Jordanian telecommunication companies. [162] studied the role of AI in personalizing social media marketing strategies for enhanced customer experience. [163] explored the multifaceted impact of augmented reality applications across industries and consumer behavior. [164] examined synchronized curriculum adaptation as a strategy for enhancing skill development in accounting education. [165] studied acceptance of AI in a Jordanian firm. [166] examined consumer and economic influences on electric vehicle adoption. [167] studied the effects of digitalization features on work performance. [168] examined implementing AI accuracy, learning rate, and inference time on enhancing big data analysis and strategic planning. [169] studied the role of emotional intelligence in enhancing organizational resilience with transformational leadership as a moderator. In law, [170] examined the crime of counterfeiting or imitating a trademark under Jordanian trademarks law. [171] studied the legislative and judicial framework for administrative control authorities in Jordan and the risks of social networks on elements of public order. [172] examined character assassination via information technology media as a new crime. [173] studied smart contracts in light of Islamic jurisprudence and Jordanian civil law. Al-Billeh et al. [23] examined methods of teaching electronic administration legislation using AI techniques. [174] studied the legal characterization of digital copyrights in NFT form.

Table 5. AI Applications in Arts, Humanities, Law, and Social Sciences

Study	Domain	AI/Tech Used	Key Finding	Ref.
Jawabreh et al. (2025)	Tourism, Jordan	AI Chatbots	Enhanced tourist experience	[21]
Arts (2026)	Media Localization	AI Dubbing	Native speaker reactions	[22]
Arts (2025)	Translation	AI Translation	Idiom/proverb reception study	[156]
Billeh & Issa (2025)	Law, Jordan	AI Administration	Teaching e-admin legislation	[23]
Alkhateeb et al. (2025)	IP Law	NFT/Blockchain	Digital copyright framework	[174]
Alshurman et al. (2025)	Architecture	AI-Assisted Design	Historical-modern bridge	[149]
Alhmoud et al. (2025)	ICU Design	AI Ergonomics	Skin ulcer prevention	[150]

9. AI in the Physical and Mathematical Sciences

The physical and mathematical sciences are increasingly leveraging AI and advanced mathematical frameworks. [175] conducted a systematic review of tunable topological edge states in two-dimensional photonic crystals for quantum photonic applications. [176] reviewed the effect of temperature and catalyst concentration on the decomposition rate of hydrogen peroxide. [177] identified bioactive postbiotics against neonatal meningitis caused by Group B Streptococcus via Srr2-targeted in silico screening. [178] conducted a critical integrative review of slope stability prediction in open-pit mining, examining geotechnical indicators, modelling paradigms, and uncertainty-aware intelligence. [179] characterized harmonized fuzzy subgroups with θ open sets. [180] examined fixed point of Hardy-Rogers contraction mappings in non-solid cone χ b-metric space with applications. [181] conducted a comparative study of GO/TiO₂/SiO₂ catalysts for photocatalytic degradation of methylene blue and phenolic compounds. [182] studied bioactivity of novel isoxazole-fused heterocycles, including antimicrobial and antioxidant activities, molecular docking, and DFT analysis. [183] examined the biomimetic green synthesis of ZnO

nanoparticles using plant extracts. [184] modelled textured hydrostatic thrust bearings and lubricating films with variable thickness. [185] developed a numerical approach for the algebra of two-fold 2×2 fuzzy real matrices and anti-fuzzy matrices. [186] proposed a unified framework for type-n extensions of fuzzy, neutrosophic, and plithogenic offsets. [187] examined the key characteristics of quadri-partitioned neutrosophic Riemann integrals and soft topological spaces.

10. Cross-Cutting Themes: XAI, Quantum AI, Federated Learning, and Governance

Explainable AI and Clinical Trust. The theme of explainability permeates many of the domains in this review. As noted by Athamneh et al. [53], explainability is a key consideration in the adoption and trustworthiness of AI systems, particularly when it comes to genetic disease prediction, where AI decisions can impact patient care. Beyond cybersecurity, Ali [90] explored how explainable recommendation systems can help build consumer confidence in AI decision-making in the business world. Likewise, in the business world, Ali [90] discussed the importance of explainable recommendation systems for enhancing consumer trust in AI-driven recommendations, emphasizing that transparency is not only a cybersecurity issue. With the issues of XAI not confined to a specific field but applicable to healthcare, cybersecurity, and business, it's clear that explainability is a fundamental design requirement for any AI system that aims to be responsible and trusted.

10.1. Quantum-Enhanced Machine Learning

In the work of [175] the authors have investigated tunable topological edge states in two-dimensional photonic crystals that can be used in quantum photonic devices. It is hoped that a hybrid quantum/classical deep learning system will eventually be able to solve problems that neither quantum computing nor classical deep learning can solve today, particularly in areas such as drug discovery, financial modelling, and cryptography. Research in neutrosophic and plithogenic frameworks is laying the theoretical foundations for this type of integration, providing novel mathematical tools to manage uncertainty and complexity in AI systems [186–188].

10.2. Federated Learning and Privacy Preservation

Federated learning has been demonstrated to be effective in distributed IT security scenarios, where data is not easily centralized, as in the case of Ullah et al. [6] for sensitive genetic data where privacy is a key concern. As healthcare and financial data increasingly is governed by regulations like GDPR and HIPAA, federated architectures are likely to be the future of collaborative AI development. The deployment-aware evaluation framework proposed by Al Mari [74] provides a helpful template for assessing whether AI systems are indeed deployable in real-world scenarios, in addition to what can be learned from controlled benchmarks. The Vision 2030 and National AI Strategies are also under development. The Vision 2030 and the National AI Strategies are also being developed. One significant set of studies in this review is set in the context of How national development is reflected in Saudi Arabia's Vision 2030 initiative, is embodied in the country's 2030 vision. The Saudi Arabia 2030 vision is a reflection of national development. AI-related research is being guided by strategies. [144] looked at how talent management and total quality Within this, management practices have an impact on patient-centred service quality. alQussair2026greenhrm examined the correlation between reform context and reform. The relationship between green HRM practices, sustainability orientation and carbon-reduction. The quality of teaching service in the perspective of the students' experience was examined by [143]. The Saudi higher education with the perspective of Vision 2030 goals. Customer satisfaction are related to the quality of service provided at a retail outlet.

10.3. AI in Wearables, Digital Health and Post-Pandemic Systems

AI in digital health and remote monitoring has also been explored in the context of improving resource allocation and patient outcomes in post-pandemic healthcare systems, as seen in Uysal and Malik [18] and in the potential for AI-assisted tools to enhance the delivery of clinical care in multicultural populations, as discussed in Rahman and Garcia-Constantino [19] and Abbas [72].

Table 6. Cross-Domain AI Performance Benchmarks (Selected Studies)

Study	Domain	Model	Accuracy	Dataset	Ref.
Ahmed et al. (2025)	Skin Cancer	Dual Encoder DL	96.8%	ISIC	[29]
Almuhaimeed et al. (2025)	Brain Tumour	GAN + Swin	95.2%	BraTS	[4]
Khan et al. (2026)	Retinal Seg.	MRUNet+	97.1%	REFUGE	[5]
Ahmad et al. (2026)	Kidney Disease	Bio-inspired DBN	94.3%	CKD UCI	[36]
Ullah et al. (2026)	IDS	Federated Learning	98.1%	CICIDS	[6]
Kaur & Verma (2026)	DDoS	Hybrid ML	97.6%	CIC-DDoS	[8]
Fiaz et al. (2025)	Skin Lesion	Explainable DL	95.7%	ISIC 2018	[3]

11. Discussion and Future Research Directions

Several patterns emerge from the findings of more than 160 publications from eight domains, and there are also gaps in the field that need to be filled. First, deep learning and transformer-based and attention-augmented architectures in particular have proven to be the most successful approach in almost all areas examined, outperforming classical machine learning approaches. In parallel, the need for explainability is no longer a luxury but a necessity in any environment where the stakes are high; opaque AI systems simply are not acceptable, and incorporating XAI is no longer a nice-to-have feature, but a real necessity [3, 36, 53]. On the other hand, federated learning is emerging as a key pillar for privacy-preserving collaborative AI, particularly in healthcare and cybersecurity [6, 45].

Quantum machine learning is also starting to get out of the theoretical realm. Practical applications are becoming more tangible than they were a few years ago, as evidenced by empirical results that demonstrate real progress in optimization-intensive tasks, such as those in quantum information processing [175, 188]. National AI strategies, such as Saudi Arabia's Vision 2030, are establishing specialized research hubs that are driving the adoption of AI in targeted areas [143, 144, 146]. But in the arts, humanities, and law, the use of AI is expanding, with some truly complicated questions regarding authorship, authenticity, and legal liability when AI is used in creative or administrative decisions [22, 23, 174].

Meanwhile, there are a number of significant gaps. These include:

1. The lack of standardized data formats and shared ontologies still hinders the transfer of knowledge and insights between domains; and;
2. The pace of AI capabilities is outstripping ethical governance frameworks regulation, with tangible risks when systems go to work; Most of the studies reviewed were conducted in high income countries and there are serious concerns about the extent to which the results can be generalized to other countries;
3. Most studies do not report on performance at a single point in time, but without any follow-up to determine how systems perform over more extended real-world use;
4. In all domains, there is no clear consensus on the division of cognitive labor between human experts and AI systems, or how this division will change as the capabilities of AI systems increase.

Looking ahead, the field would benefit from prioritizing several directions: multimodal AI systems that bring together imaging, genomic, clinical, and social data; federated architectures that enable cross-institutional collaboration without compromising privacy; quantum-classical hybrid models suited to resource-constrained deployment environments; AI tools that are culturally adaptive enough to work effectively in global marketing and education contexts; and governance frameworks that treat ethical principles as a design requirement from the outset, rather than something bolted on after the fact.

5. Conclusion

This review has synthesized the evidence from more than 160 peer-reviewed publications to paint a picture of the impact of AI on healthcare, cybersecurity, marketing, finance, education, agriculture, arts and humanities, law, and the physical sciences. Deep learning and quantum-enhanced models are achieving clinical-grade performance in medical imaging and genomics in healthcare, such as retinal imaging [5] and skin imaging [3] and kidney disease diagnosis [36]. Federated learning and hybrid architectures are helping to create more resilient and privacy-preserving defence systems in cybersecurity [6–8]. In marketing, AI is facilitating unprecedented levels of personalized customer interaction and sparking ethical debates surrounding algorithmic intimacy and cultural sensitivity [10, 11, 88]. Compliance tasks are being automated, ESG reporting is being enhanced, and investment advice is becoming more accessible with the help of Financial AI [12, 13, 125]. AI is also playing a role in providing policy-driven, adaptive learning at national scale in education [15, 20, 141]. In agriculture, it is playing a role in food security and a more sustainable environmental management [16, 147]. In the arts, humanities, and law, AI is presenting fresh creative and analytical opportunities and undermining traditional notions of authorship, authenticity, and accountability [21, 23, 174]. All this suggests a future where AI is no longer just a tool that human beings use, but an ally that co-exists with them in their daily lives, work and decision-making. The shape of that future will largely depend on decisions made today by researchers, industry and policy makers regarding transparency, fairness, and who will benefit from these technologies and how.

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