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Review

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Top Ten Transformative Impacts of Artificial Intelligence on Life Sciences

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Abstract

Artificial intelligence (AI) is rapidly transforming the life sciences, revolutionizing biomedical research, diagnostics, therapeutics, and public health. Its ability to analyze complex data and uncover hidden patterns enables new solutions to long-standing biological challenges. This comprehensive review aims to identify and summarize the top 10 most impactful applications of AI across the life sciences, showcasing how AI technologies are reshaping key areas from drug discovery to public health surveillance. A narrative review approach was employed to synthesize recent advances and landmark developments across 10 major domains where AI has demonstrated transformative impact. Literature and case studies were examined to highlight the integration of AI tools in both research and clinical practice. Key areas of AI impact include: 1) drug discovery and development via predictive modeling and molecular generation, exemplified by AlphaFold; 2) precision medicine through integration of multi-omics and clinical data; 3) AI-assisted diagnostics in radiology and pathology; 4) omics data interpretation to uncover biomarkers and disease mechanisms; 5) clinical decision support using real-time data synthesis; 6) knowledge graphs for systems biology and drug-disease-gene relationships; 7) protein and enzyme design in synthetic biology; 8) clinical trial optimization via improved recruitment and risk prediction; 9) AI-driven public health surveillance; and 10) laboratory automation to enhance reproducibility and throughput. AI is not only accelerating discovery and development across the life sciences but also is fundamentally transforming how biomedical science is conducted. As AI technologies continue to evolve, they are poised to become indispensable tools for advancing healthcare innovation and addressing future biological challenges.

Keywords: Artificial intelligence; Life sciences; Drug discovery; Precision medicine; Medical imaging; Omics integration; Clinical decision support; Laboratory automation

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Introduction

Artificial intelligence (AI) is revolutionizing life sciences, driving unprecedented advancements in drug discovery, diagnostics, personalized medicine, and biological research. By leveraging machine learning (ML), particularly deep learning and natural language processing (NLP), AI enables researchers to analyze vast datasets, uncover patterns, and accelerate innovation with precision and efficiency. From predicting protein structures to optimizing clinical trials, AI's transformative potential is reshaping how we understand and address complex biological challenges. This introduction explores the profound impacts of AI on life sciences, highlighting its role in enhancing research, improving patient outcomes, and reducing costs.

In drug discovery, AI models like AlphaFold have solved decades-old problems, such as protein folding, enabling faster therapeutic development [1]. In diagnostics, AI-powered tools achieve near-human accuracy in detecting diseases from medical imaging, as demonstrated by studies on AI-driven radiology [2]. Personalized medicine benefits from AI's ability to analyze genomic data, tailoring treatments to individual patients [3]. Additionally, AI streamlines clinical trials by identifying suitable candidates and predicting outcomes, reducing time and costs [4].

Recent advancements underscore AI's growing influence. For instance, generative AI models are designing novel molecules for drug development [5]. Meanwhile, AI-driven bioinformatics tools are decoding complex genomic datasets, advancing precision medicine [6]. These innovations highlight AI's potential to transform life sciences, paving the way for breakthroughs that were once unimaginable.

This article explores the top 10 impacts of AI, showcasing its role in shaping the future of healthcare and biological discovery. AI tools like ChatGPT, DeepSeek, and Grok are transforming life sciences across 10 key domains (Fig. 1 and Table 1). We highlight the most common areas of impact identified by these models, ranked by frequency and relevance. AI accelerates drug discovery, predicts protein structures, and personalizes care through precision medicine. In medical imaging, AI matches or surpasses human diagnostics, while in genomics and omics, it deciphers complex biological data. Clinical decision support is enhanced by AI's integration of electronic health record (EHR) and predictive analytics. Knowledge graphs (KGs) uncover hidden gene-disease-drug links, and AI advances synthetic biology via protein and enzyme design. AI optimizes clinical trials by improving recruitment and out-

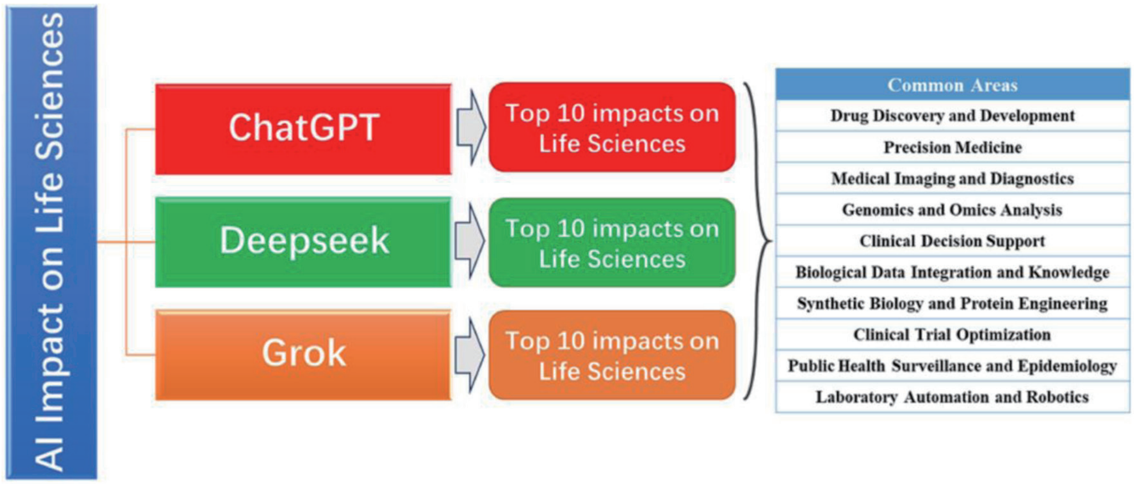

Figure 1. Top 10 impacts of artificial intelligence (AI) on life sciences. This figure illustrates the key domains where AI technologies are transforming life sciences research and application. We highlight the most common intersections among ChatGPT, DeepSeek, and Grok, ranked by frequency and relevance. From accelerating drug discovery and development to enabling precision medicine, AI enhances decision-making by integrating vast and complex biomedical data. Medical imaging and diagnostics benefit from AI-powered image recognition, while genomics and omics analysis leverage machine learning to interpret large-scale sequencing data. Clinical decision support systems use AI to improve patient outcomes, and biological data integration facilitates knowledge extraction from heterogeneous sources. In synthetic biology and protein engineering, AI aids in designing novel biomolecules and functions. Clinical trial optimization is advanced through predictive analytics, improving recruitment and success rates. AI also plays a crucial role in public health surveillance, modeling disease spread and guiding interventions. Finally, laboratory automation and robotics streamline experimental workflows, enabling high-throughput and reproducible research. Collectively, these domains highlight the profound and multidisciplinary influence of AI on modern life sciences.

come prediction. Lastly, lab automation powered by AI boosts research speed, scalability, and reproducibility (Fig. 2).

Drug Discovery and Development

AI is revolutionizing drug discovery and development by streamlining and accelerating processes that traditionally required years of work and immense financial investment. AI can efficiently predict molecule-target interactions using deep learning models trained on chemical structures, protein databases, and biological activity data. These models help identify potential drug candidates by forecasting binding affinities, off-target effects, and pharmacokinetic properties [7].

One major application is *de novo* drug design, where AI algorithms generate novel molecular structures optimized for specific biological targets. Generative models such as variational autoencoders (VAEs), generative adversarial networks (GANs), and reinforcement learning frameworks are used to create compounds with desirable drug-like properties [5]. These methods significantly reduce the time and cost needed for initial lead discovery and optimization.

AI also plays a pivotal role in clinical trial design and recruitment. ML models can analyze real-world data (e.g., EHRs, multi-omics data) to identify patient subgroups most likely to respond to a therapy, thus enhancing trial efficiency and reducing attrition [3, 4].

Perhaps the most widely celebrated breakthrough in this space is AlphaFold, developed by DeepMind. In 2020, AlphaFold demonstrated an unprecedented ability to accurately predict protein 3D structures from amino acid sequences, solving a 50-year grand challenge in biology. This innovation enables researchers to better understand disease mechanisms and accelerate the identification of druggable targets [1, 8]. The open release of AlphaFold-predicted structures for the human proteome has already catalyzed new research and drug development programs across academia and industry.

Precision Medicine

AI is a driving force behind the advancement of precision medicine, where treatment strategies are tailored to the individual characteristics of each patient. This approach integrates diverse data types, such as genomic, transcriptomic, proteomic, metabolomic, and EHR data, using advanced ML models to predict disease risk, treatment responses, and optimal interventions.

AI algorithms excel at analyzing large, multidimensional datasets, uncovering complex patterns that are not apparent through conventional methods. For instance, deep learning models can identify gene expression signatures associated with therapy response or resistance, enabling personalized treatment decisions [9]. In oncology, AI models have been used to match patients to targeted therapies based on tumor mutation profiles, leading to better clinical outcomes [10].

EHRs, which contain longitudinal data on patient history, medications, and lab results, can be mined using NLP and ML to generate predictive risk models. These models support clinical decision-making in areas such as cancer care, cardiology,

Table 1. Top 10 Impacts That AI May Have on Life Sciences Identified by ChatGPT, DeepSeek and Grok

Impact area	How AI transforms life sciences, ChatGPT (C)
Drug discovery	Accelerates identification of drug candidates and repurposing existing drugs.
Genomics and precision medicine	Analyzes genetic data to tailor treatments and predict disease risks.
Medical imaging and diagnostics	Enhances accuracy in detecting tumors, neurological disorders, etc.
Biomarker discovery	Identifies novel biomarkers for diseases using large datasets.
Clinical trials optimization	Improves patient recruitment, trial design, and real-time monitoring.
Synthetic biology	Designs novel enzymes, metabolic pathways, or organisms for biotech.
Antibiotic resistance	Discovers new antibiotics or combats resistant pathogens.
Aging and longevity research	Analyzes aging mechanisms and identifies anti-aging interventions.
Public health surveillance	Tracks outbreaks and models disease spread (e.g., pandemics).
Lab automation	Robots + AI automate repetitive lab tasks (pipetting, cell culture).
Impact area	How AI transforms life sciences, DeepSeek (D)
Drug discovery	Accelerates molecule screening, predicts drug efficacy, and repurposes existing drugs.
Precision medicine	Tailors treatments using genomics, biomarkers, and patient-specific data.
Medical imaging analysis	Enhances radiology/pathology diagnostics (e.g., tumors, neurological disorders).
Clinical trial optimization	Improves patient recruitment, predicts trial outcomes, and reduces costs.
Biomarker discovery	Identifies disease signatures for early diagnosis and targeted therapies.
Synthetic biology	Designs novel enzymes, genetic circuits, and bio-manufacturing pathways.
Public health surveillance	Tracks outbreaks, models disease spread, and optimizes interventions.
Lab automation	Automates high-throughput screening, data analysis, and robotic experiments.
Antibiotic resistance	Discovers new antibiotics and optimizes combinations against superbugs.
Gene editing and CRISPR	Improves precision in gene-editing tools (e.g., CRISPR) for therapeutic applications.
Impact area	How AI transforms life sciences, Grok (G)
Drug discovery acceleration	AI models predict molecular interactions, identify drug candidates, and optimize compounds, accelerating discovery time.
Personalized medicine	AI analyzes genomic and patient data to tailor treatments, improving outcomes for diseases like cancer through precision therapies.
Medical imaging analysis	AI enhances diagnostic accuracy by detecting patterns in X-rays, MRIs, and CT scans, identifying conditions earlier.
Genomics and gene editing	AI processes vast genomic datasets to identify disease-related genes and guide CRISPR-based therapies for genetic disorders.
Clinical trial optimization	AI predicts patient eligibility, monitors trials in real-time, and reduces dropout rates, making trials faster and more cost-effective.
Disease prediction and prevention	Machine learning models analyze health records and lifestyle data to predict risks for diseases, enabling proactive interventions.
Biomarker discovery	AI identifies novel biomarkers for early disease detection, improving diagnostics for conditions like cancers.
Synthetic biology	AI designs synthetic organisms or pathways for producing biofuels, drugs, or sustainable materials in biotechnology applications.
Healthcare workflow automation	AI streamlines administrative tasks, such as medical coding or patient scheduling, allowing clinicians to focus on care delivery.
Epidemiology and public health	AI models track disease outbreaks, predict spread (e.g., COVID-19), and optimize vaccine distribution strategies using real-time data.

COVID-19: coronavirus disease 2019; CT: computed tomography; MRI: magnetic resonance imaging.

and diabetes management [11]. In one example, the PREDICT algorithm, developed by the UK's National Health Service (NHS), uses patient-specific tumor and demographic data to guide breast cancer treatment decisions, improving both survival outcomes and quality of life [12].

The integration of AI into tumor profiling has been trans-

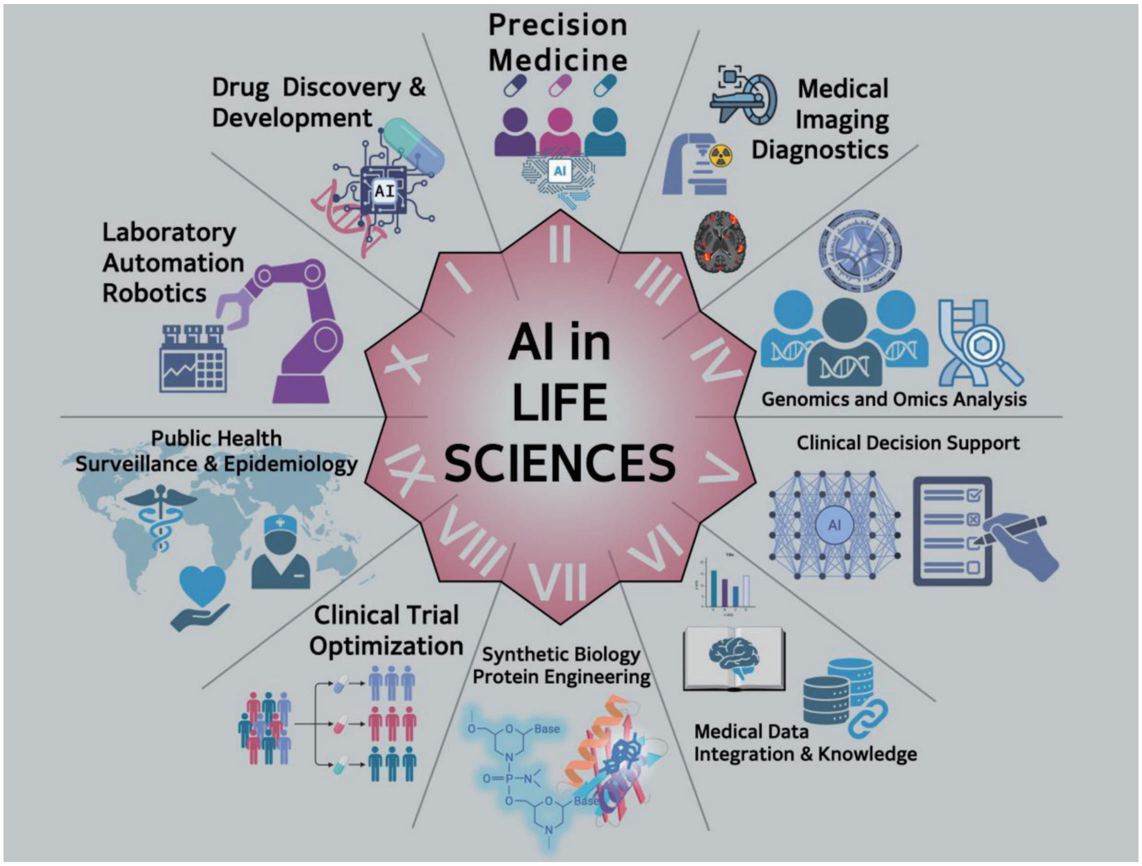

Figure 2. The top 10 impacts of artificial intelligence (AI) on life sciences. This diagram highlights 10 key domains where AI is transforming life sciences. AI is accelerating drug discovery and development by predicting molecular activity and optimizing compound screening. In precision medicine, it integrates genomic, clinical, and lifestyle data to tailor therapies. AI enhances medical imaging and diagnostics through advanced pattern recognition, improving detection of diseases from radiological and histological data. In genomics and omics analysis, machine learning deciphers complex datasets to identify disease mechanisms. Clinical decision support systems use AI to improve diagnosis and treatment recommendations. AI facilitates biological data integration and knowledge extraction by synthesizing insights across diverse sources. In synthetic biology and protein engineering, it enables design and modeling of novel biomolecules. AI improves clinical trial optimization by enhancing recruitment, predicting outcomes, and reducing costs. Public health surveillance and epidemiology benefit from AI's predictive capabilities for disease outbreaks. Finally, laboratory automation and robotics streamline workflows and increase research productivity.

formative. Tools like IBM Watson for Genomics interpret sequencing data to suggest personalized cancer treatment options, drawing on curated literature, clinical guidelines, and trial databases [13].

Medical Imaging and Diagnostics

AI is significantly enhancing the accuracy, speed, and consistency of medical imaging interpretation across radiology and pathology, two of the most data-intensive fields in healthcare. By leveraging deep learning, especially convolutional neural networks (CNNs), AI systems can process complex image data to detect patterns that may escape human observers, offering powerful decision-support tools for clinical diagnosis.

In radiology, AI models have been trained to analyze computed tomography (CT) scans, magnetic resonance imaging (MRI), and X-rays to detect abnormalities such as lung nodules, fractures, brain hemorrhages, and signs of pneumonia. One landmark study by McKinney et al demonstrated that a deep learning system developed by Google Health outperformed human radiologists in detecting breast cancer on mammograms [14]. Similarly, AI has shown promise in identifying lung cancer from low-dose CT scans, with performance comparable to or exceeding that of expert radiologists [15].

In digital pathology, AI is being used to analyze high-resolution histopathological slides for cancer grading, biomarker quantification, and detection of rare cellular events. For example, AI systems have demonstrated expert-level performance in diagnosing prostate cancer from biopsy slides and in detecting lymph node metastases in breast cancer [16]. These tools offer high-throughput, reproducible assessments that assist pathologists in making more accurate diagnoses.

Importantly, AI can also standardize interpretations, minimize diagnostic variability, and improve access to expert-level diagnostics in underserved or remote areas. As regulatory approvals increase, AI-powered diagnostic tools are being integrated into clinical workflows worldwide, enhancing both diagnostic precision and efficiency.

Genomics and Omics Analysis

AI plays a critical role in unlocking insights from the high-dimensional and complex datasets generated by modern omics technologies - genomics, transcriptomics, proteomics, and metabolomics. These data layers are essential for understanding the molecular basis of disease, identifying therapeutic targets, and developing personalized treatments.

In genomics, AI algorithms accelerate the detection and annotation of genetic variants from whole-genome or exome sequencing data. Traditional pipelines rely heavily on rule-based filters and manual curation, but AI-based tools can prioritize functional and disease-relevant mutations with greater accuracy. Deep learning models like DeepVariant, developed by Google, have been shown to outperform conventional methods in identifying single nucleotide variants and insertions/deletions from sequencing data [17].

In transcriptomics, ML helps uncover hidden gene expression patterns, regulatory modules, and disease subtypes. For example, unsupervised learning techniques such as clustering and dimensionality reduction (e.g., t-distributed stochastic neighbor embedding (t-SNE), uniform manifold approximation and projection (UMAP)) are used to analyze single-cell RNA-seq data, revealing cellular heterogeneity and lineage trajectories in cancer, immune responses, and development [18].

Proteomics and metabolomics also benefit from AI in spectral data analysis, biomarker discovery, and pathway modeling. AI methods enable the integration of multi-omics data, offering a holistic view of biological systems and revealing novel disease mechanisms. Multi-modal ML approaches are especially powerful in identifying cross-talk between genomic alterations and downstream protein or metabolite changes [19].

The ultimate impact of AI in omics is its ability to translate massive datasets into actionable insights, from identifying cancer-driving mutations to uncovering metabolic signatures of neurodegenerative diseases, thus transforming both research and clinical practice.

Clinical Decision Support

AI-powered Clinical Decision Support Systems (CDSS) are transforming how clinicians interpret patient data and make diagnostic and treatment decisions. These tools combine ML, NLP, and real-time data analytics to recommend diagnoses, predict risks, or suggest treatment strategies based on current evidence and patient-specific characteristics.

One major advantage of AI in CDSS is its ability to synthesize complex and large-scale data, including EHRs, imaging, genomics, and biomedical literature. AI models can flag potential diagnostic errors, suggest differential diagnoses, predict disease progression, and alert clinicians to adverse drug interactions, all of which enhance patient safety and reduce cognitive burden [20].

Early applications like IBM Watson for Oncology showcased the potential of AI to match patients with evidence-based cancer treatments. By integrating clinical guidelines, medical literature, and patient data, Watson aimed to recommend personalized treatment options. In a study from India, Watson's treatment recommendations aligned with oncologists' decisions in over 90% of breast cancer cases, demonstrating clinical concordance [21].

Beyond oncology, AI-CDSS tools have been successfully implemented for sepsis detection, heart failure prediction, and triage support in emergency medicine. For example, DeepMind developed an AI system capable of predicting acute kidney injury (AKI) up to 48 h before onset, enabling earlier intervention and improved outcomes [22].

Despite these promising results, the integration of AI into clinical workflows requires rigorous validation, clinician oversight, and transparency in algorithmic decision-making. When properly implemented, AI-CDSS can significantly improve diagnostic accuracy, reduce medical errors, and contribute to more consistent, equitable care.

Biological Data Integration and KGs

AI plays a pivotal role in integrating heterogeneous biomedical data sources, including scientific literature, omics datasets, drug databases, and clinical trial results, into structured knowledge networks such as KGs. These AI-driven frameworks enable researchers to uncover novel relationships between genes, diseases, drugs, and phenotypes, facilitating systems-level understanding of biology and accelerating hypothesis generation.

KGs organize information as nodes (e.g., genes, proteins, diseases, drugs) and edges (relationships between them), enabling semantic reasoning and pattern discovery. AI techniques such as NLP and graph neural networks (GNNs) help automate KG construction and inference from unstructured text (e.g., PubMed abstracts) and structured databases (e.g., DrugBank, OMIM). For instance, ML over literature-derived KGs proposes previously unknown disease-gene associations and drug repurposing opportunities [23, 24].

In systems biology, integrating omics data with KGs allows dynamic modeling of pathways and molecular networks, such as those involved in cancer progression or immune regulation. These models support biomarker discovery, drug target prioritization, and prediction of combinatorial therapies [25]. For example, Hetionet, an integrative KG combining 29 public biomedical resources, has been used to systematically predict new drug-disease relationships [26].

AI-powered data integration also enhances the interpretability of high-throughput experiments by connecting genes or proteins of interest to known biological processes, phenotypes, or clinical outcomes, significantly improving research productivity and translational relevance.

Synthetic Biology and Protein Engineering

AI is rapidly advancing synthetic biology and protein engineering by enabling the rational design of biological molecules such as enzymes, therapeutic proteins, and synthetic genetic circuits. Traditionally, protein engineering relied on trial-and-error mutagenesis and labor-intensive screening. Today, AI, especially deep learning, facilitates the prediction of structure-function relationships, *de novo* protein design, and synthetic pathway optimization with unprecedented precision.

Generative models, including VAEs, GANs, and transformers, can create novel protein sequences tailored for specific functions. Tools such as ProtGPT2 and ESMFold, trained on massive protein databases, can suggest mutations that enhance stability, binding, or catalytic efficiency [27, 28].

AI is also transforming enzyme design. Deep learning models can predict active site architecture, substrate specificity, and evolutionary fitness, accelerating the discovery of enzymes for applications in biocatalysis, biofuels, and environmental remediation. For example, ML has been used to engineer more efficient PETase enzymes for degrading plastic waste [29].

In metabolic engineering, AI guides the optimization of microbial biosynthetic pathways by identifying genetic modifications that improve yield, minimize byproducts, and balance flux in organisms such as *E. coli* and *S. cerevisiae*. Reinforcement learning frameworks enable iterative optimization of synthetic pathways *in silico* before lab implementation [30].

Furthermore, AI contributes to CRISPR guide RNA design by improving on-target efficiency and minimizing off-target effects. Predictive tools like DeepCRISPR and CRISPR-Net support customized genome editing strategies for therapeutic applications.

Clinical Trial Optimization

AI is increasingly used to optimize clinical trials, addressing long-standing challenges such as patient recruitment, trial design, and outcome prediction. By analyzing vast volumes of real-world data, particularly from EHRs, imaging, genomic profiles, and claims data, AI supports more efficient, precise, and cost-effective clinical trial execution.

One of the major barriers to trial success is patient recruitment, with over 80% of trials failing to meet enrollment targets. AI algorithms can mine EHRs to automatically identify patients who meet complex inclusion and exclusion criteria, significantly accelerating recruitment timelines. For example, deep learning systems can extract both structured and unstructured data, such as diagnosis codes, lab values, and clinical notes, to screen candidates at scale [31].

AI also improves patient stratification by identifying subgroups more likely to respond to a given therapy, enabling adaptive trial designs and personalized interventions. In oncology, predictive models that combine genomic and phenotypic data help select high-responder populations, increasing trial efficiency and statistical power [32].

Another important application is dropout risk prediction. ML models trained on demographic, behavioral, and clinical variables can flag participants at risk of non-adherence or attrition, allowing for early intervention and improved retention [33].

AI tools are also used to simulate virtual control arms, optimize endpoint selection, and enable real-time trial monitoring. These capabilities reduce trial duration and costs. Major pharmaceutical companies such as Pfizer, Novartis, and Roche are integrating AI across the clinical trial pipeline to accelerate regulatory approvals and reduce development risks.

Public Health Surveillance and Epidemiology

AI has become a powerful tool in public health surveillance and epidemiology, offering real-time, data-driven insights for tracking disease outbreaks, predicting epidemic trends, and guiding public health policy. Traditional surveillance methods often suffer from latency and limited granularity, while AI enables faster, more scalable, and more accurate detection and forecasting of disease spread.

One landmark example is BlueDot, a Canadian company that uses NLP and ML to scan over 100,000 global data sources daily, including news articles, airline data, and health reports. BlueDot detected early signs of the coronavirus disease 2019 (COVID-19) outbreak in Wuhan on December 31, 2019, days before the World Health Organization issued a public alert [34].

AI is also essential in pandemic modeling, helping simulate disease transmission dynamics and evaluate the impact of public health interventions. For instance, deep learning models combined with compartmental approaches (e.g., susceptible, exposed, infectious, and recovered (SEIR) models) were used to predict COVID-19 cases, hospital loads, and the effectiveness of lockdowns and vaccination campaigns [35].

In addition, AI tools mine social media, mobility patterns, and search engine trends to identify early signs of emerging health threats. Platforms like HealthMap and the now-retired Google Flu Trends exemplify this approach, using digital footprints as proxies for real-world epidemiological trends.

Beyond infectious disease, AI is increasingly applied to chronic disease epidemiology, environmental exposure analysis, and the study of social determinants of health, supporting more proactive and predictive public health strategies.

Laboratory Automation and Robotics

AI-powered laboratory automation and robotics are transforming the pace and precision of biomedical research. These intelligent systems streamline repetitive and time-consuming tasks, such as pipetting, plating, imaging, and data logging, while enabling real-time decision-making and adaptive experimentation based on live feedback from data.

In high-throughput screening (HTS), AI-driven robots can handle thousands of experimental conditions simultaneously, analyzing chemical libraries or genetic perturbations at a scale unmanageable by humans. These platforms incorporate computer vision, sensor technologies, and ML to identify patterns in assay outputs, reducing false positives and optimizing experimental conditions [36].

One groundbreaking example is the “robot scientist” Eve, which uses AI to automate the design, execution, and analysis of drug discovery experiments. Eve was able to independently identify a potential antimalarial compound by screening and analyzing a library of existing drugs, demonstrating how autonomous labs can generate meaningful biological discoveries [37].

AI also plays a key role in adaptive laboratory evolution (ALE), where microbial strains or proteins are evolved for improved traits. Algorithms guide the selection of conditions or mutations based on predicted performance, significantly accelerating evolution cycles [38].

Furthermore, real-time AI analytics are integrated into platforms like Lab-on-a-Chip systems and automated microscopy, allowing for instant feedback loops where experimental parameters are adjusted on the fly to maximize data quality and biological relevance. These technologies boost reproducibility and scalability, addressing major challenges in biomedical research reproducibility [39].

As AI-integrated robotics become more accessible, they are democratizing access to intelligent laboratories, allowing researchers to run complex experiments with minimal manual intervention, transforming productivity across academia, biotech, and pharma [40].

Conclusion

AI is revolutionizing life sciences by accelerating discoveries and improving healthcare outcomes. In drug development, it enables faster therapeutic candidate identification and optimized clinical trials. Precision medicine leverages AI to analyze complex patient data for personalized treatments. Diagnostic tools achieve expert-level accuracy in medical imaging and pathology, while multi-omics analysis uncovers novel disease mechanisms. AI-powered clinical decision systems enhance diagnosis and treatment planning. KGs integrate diverse biological data, revealing new therapeutic insights. Synthetic biology benefits from AI-designed proteins and enzymes, and clinical trials become more efficient through improved patient selection and retention. Public health systems utilize AI for early outbreak detection and pandemic modeling. Laboratory automation, enhanced by AI, increases research reproducibility and throughput. Together, these applications demonstrate AI's transformative potential across the entire biomedical spectrum, from fundamental research to clinical implementation, ushering in a new era of data-driven, efficient, and personalized life sciences innovation. Continued advancements promise even greater impacts as AI technologies mature and integrate deeper into scientific workflows.

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None to declare.

Conflict of Interest

The authors have no conflict of interest to disclose.

Author Contributions

Geng Zang and Zilong Wang conceptualized and designed the study. They both conducted the literature review, analyzed the scientific advancements across the 10 AI application domains, and synthesized the findings into a cohesive manuscript. They also used AI platforms to draft and revise the manuscript for intellectual content. Both authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Data Availability

The authors declare that data supporting the findings of this study are available within the article.

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