AI-Powered Revolution in Drug Discovery: Transforming R&D and Financial Growth

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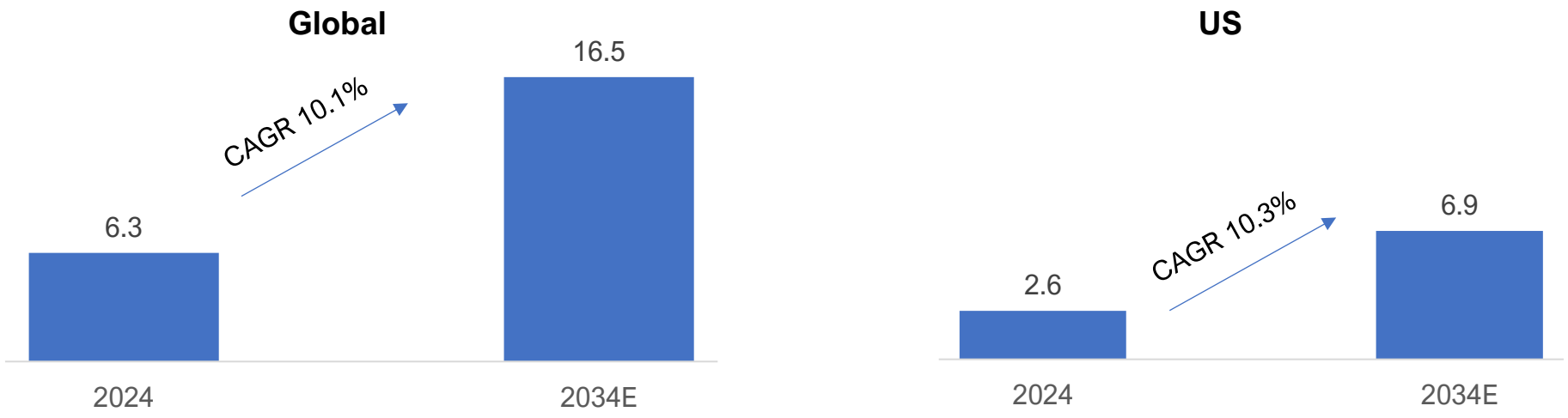
Robust Growth of AI in Drug Discovery: Market Projections Through 2034

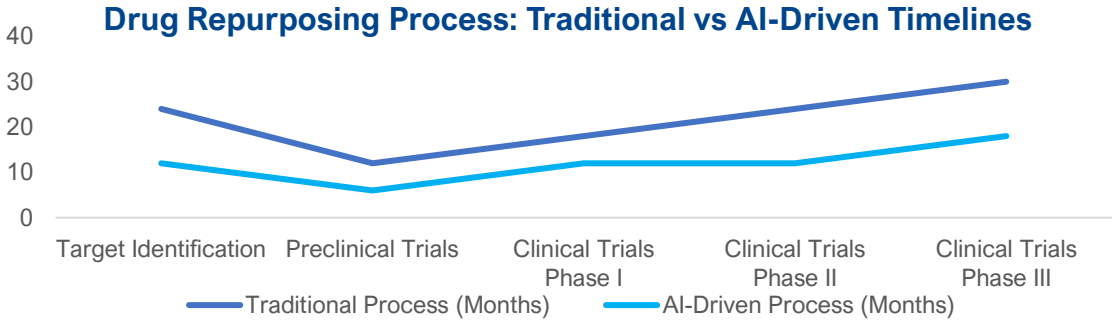
- The global artificial intelligence (AI) in drug discovery market was valued at **USD 6.3 billion in 2024** and is expected to expand at a CAGR of 10.1% to **~USD 16.5 billion** from 2025 to 2034.
- Historically, the US has led the AI driven drug discovery market, accounting for a **41% share of global revenue** in the artificial intelligence drug discovery market **in 2024.** This significant market share can be attributed to increased research funding, government initiatives promoting precision medicine in the US, and the growing adoption of AI-based tools in R&D among major pharmaceutical companies in the region.
- According to the WHO, nearly 2 billion people, or one quarter of the global population, lack access to essential medicines. The development of a single drug can cost between $1.3 billion and $4 billion, taking 10–15 years, with an 88% chance of failure during clinical trials.
- In terms of application, drug optimization and drug repurposing accounted for 51% revenue share in 2024 and is expected to register the fastest growth during the forecast period.

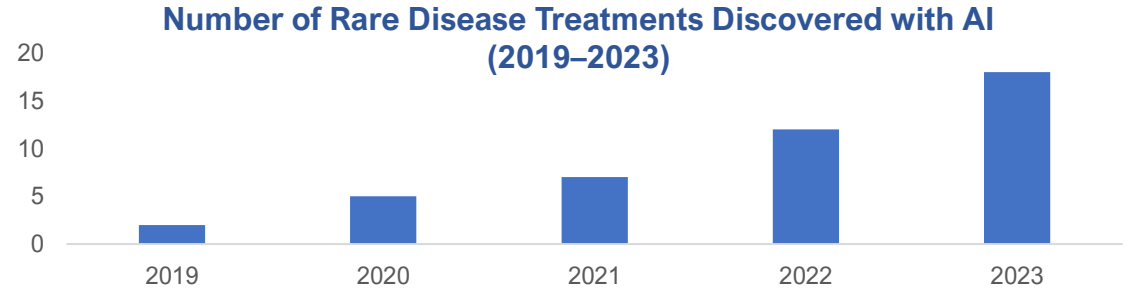
AI driven Drug Discovery Market ($ bn)

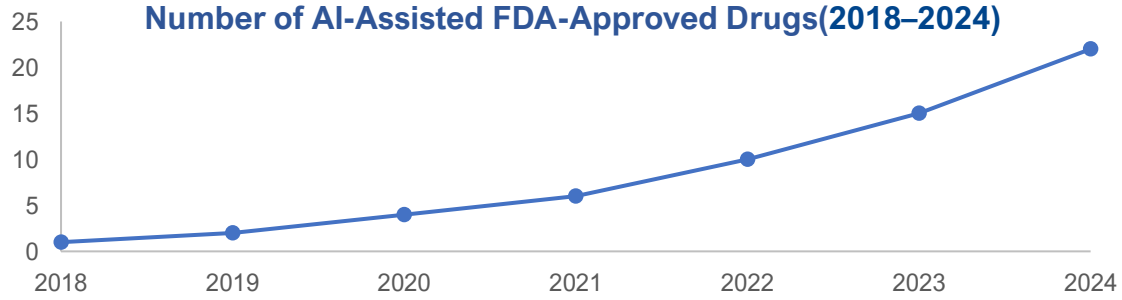


Source: www.precedenceresearch.com

AI-Driven Breakthroughs: Accelerating Drug Repurposing, Discovery, and FDA Approvals with Significant Financial Upside



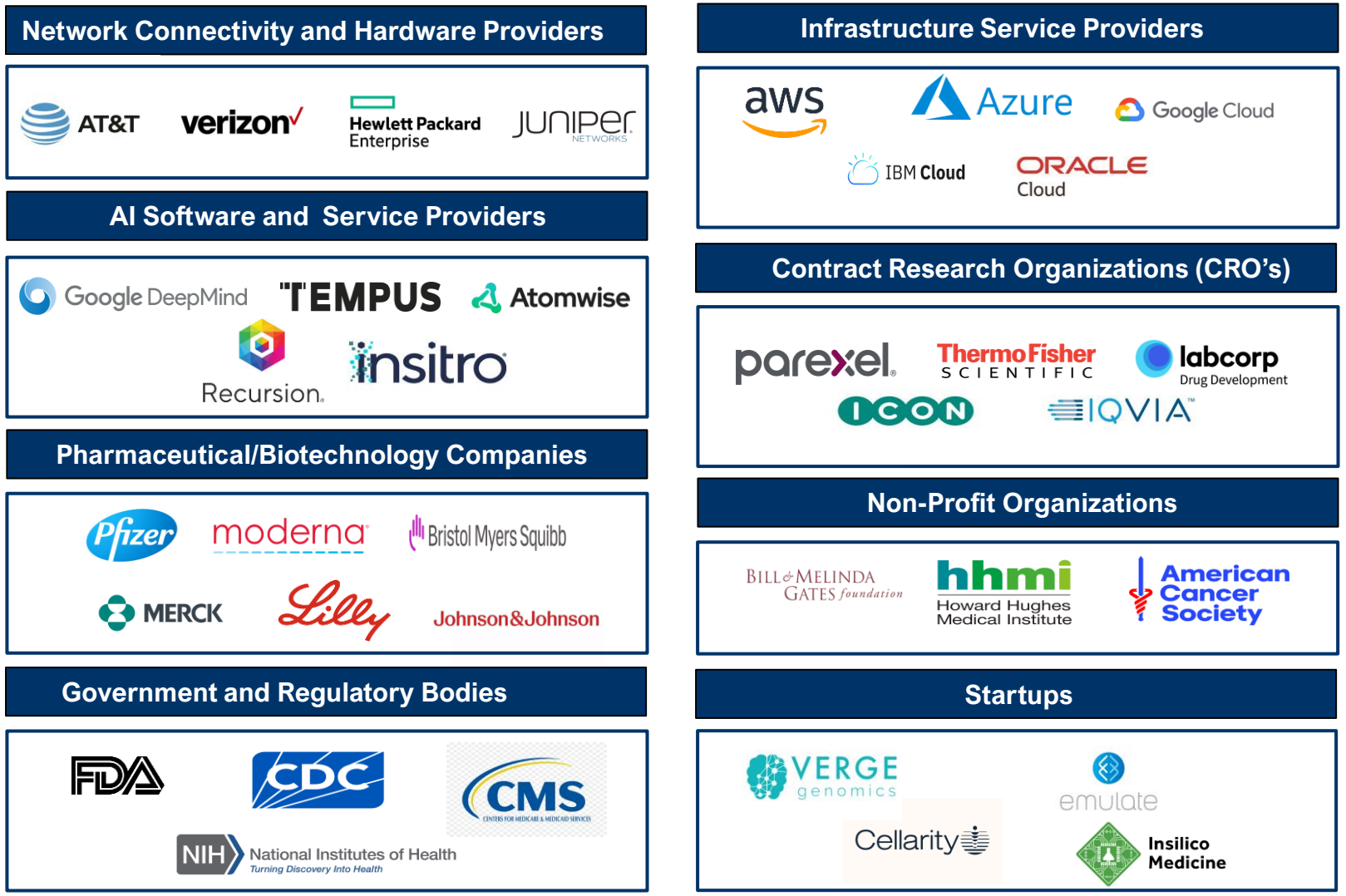




Source: www.nature.com
BioPharmaTrend: Where Tech Meets Bio

- AI significantly reduces the time required for drug repurposing across clinical phases, with **AI-driven processes being up to 40% faster.**
- Target identification and clinical trial phases particularly benefit from AI, cutting down months of manual research and experimentation.
- One of the most significant breakthroughs is the development of an AI tool by researchers at Harvard Medical School, **TxGNN**, which identified drug candidates from existing medicines for over 17,000 rare diseases. This is a huge advancement because these diseases previously had limited or no treatments.
- AI tools like **AlphaFold** have revolutionized drug discovery by predicting 3D protein structures with high accuracy, accelerating the identification of drug targets, especially in oncology and rare genetic disorders.
- **The rapid increase in AI-assisted FDA approvals** from 2018 to 2024 highlights the growing impact of AI in accelerating drug discovery and approval processes. This surge has resulted in significant cost reductions, faster timelines, and greater investor interest in AI-driven pharma, with market growth expected to accelerate significantly in the coming years.

AI in Drug Discovery: Mapping the Ecosystem of Industry Leaders and Innovators



Source: AI in Drug Discovery Market Growth Drivers & Opportunities (marketsandmarkets.com)

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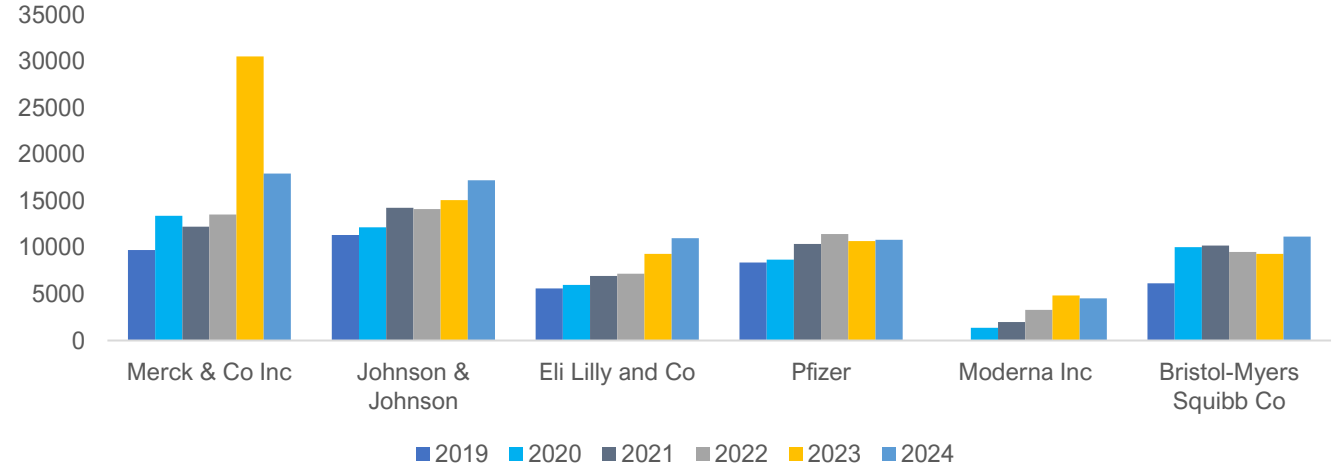
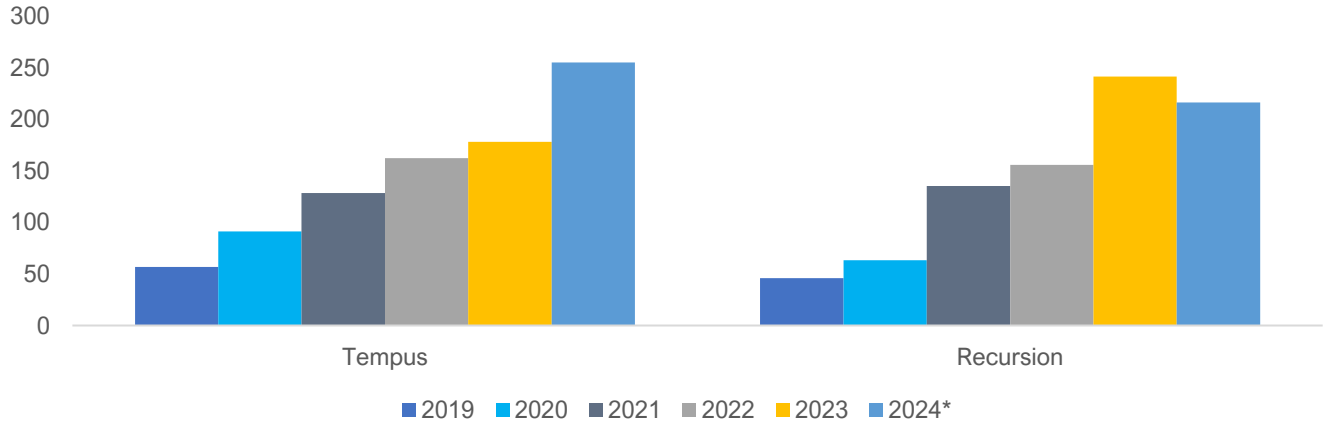
Capital Allocation in Innovation: R&D Spending Dynamics in Pharmaceuticals, and AI Software and Service Providers

Biotechnology/Pharmaceutical Companies ($mm)



- **Merck & Co Inc** increased its investment in AI driven drug development for Oncology and Pulmonology, leading to a spike in its R&D spend in 2023.
- **Johnson & Johnson (J&J), Eli Lilly, Pfizer, and Bristol-Myers Squibb** exhibit consistent R&D investment patterns, emphasizing incremental focus on innovation.
- Furthermore, J&J mentioned in its 4Q'24 earnings call that it plans to invest $5.3 bn (~24% of 2024 sales) in AI driven drug development.

AI Software and Service providers ($mm)

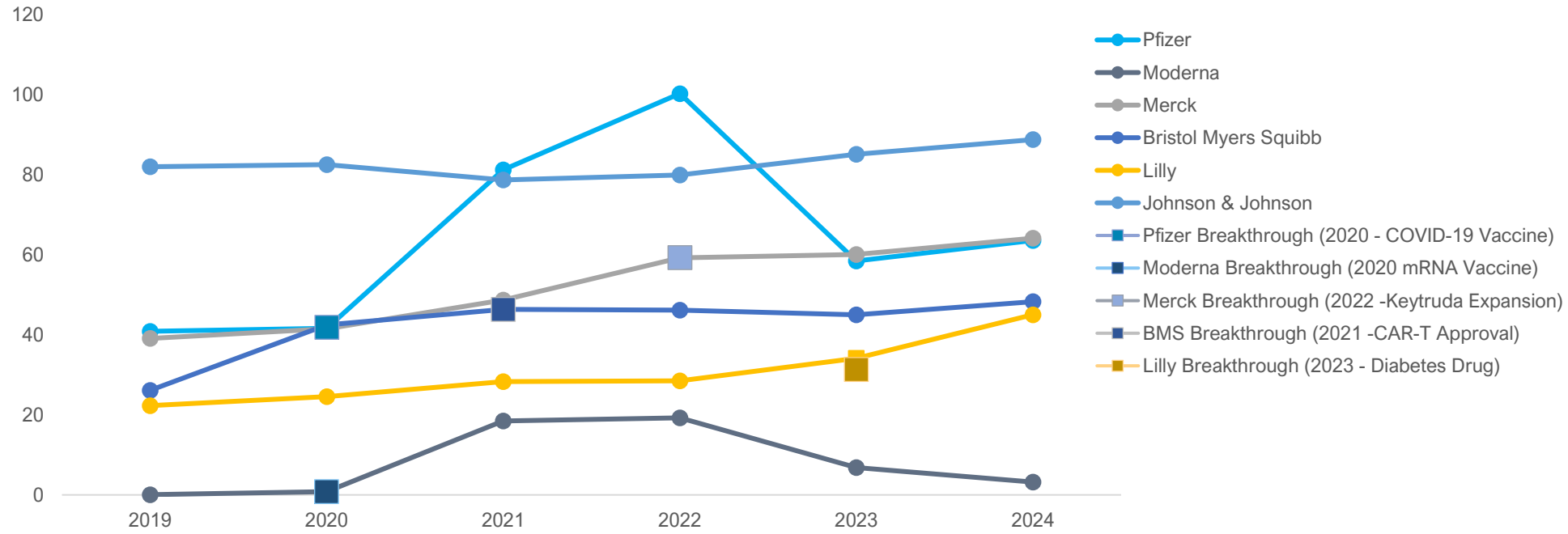


- **Tempus** and **Recursion** are consistently increasing their investments in R&D to advance its genomic and precision medicine technologies.

*Source: SEC Filings, Bloomberg * As of Sep 30, 2024*

Financial Impact of Major Drug Breakthroughs Across Leading Pharma Companies

Revenue of Key Pharma Companies (2019–2024) with Breakthrough points



- **Pfizer** experienced a major revenue boost in 2021 due to the success of its **COVID-19 vaccine, Comirnaty**, but saw a dip in 2023 as demand normalized post-pandemic.
- **Moderna**, a much smaller company pre-2020, saw its revenues skyrocket due to its **COVID-19 vaccine, Spikevax**, marking its breakthrough in 2021. Revenues have stabilized since then.
- **Merck** shows consistent growth with **Keytruda's expansion into various cancer treatments**, pushing its revenues upward from 2022.
- **Bristol Myers Squibb** acquired **Celgene** and continued to see steady revenue growth post-2021 after the approval of CAR-T therapies.
- Lilly's continued advancements in diabetes treatments, particularly with Trulicity, led to incremental revenue growth, culminating in strong numbers in 2023.

Source: www.precedenceresearch.com , SEC Filings Bloomberg

Strategic M&As and Partnerships Driving Breakthrough Innovations in Pharma

Company	Mergers	Acquisitions	Partnerships	Major Breakthroughs
Pfizer	Pfizer's merger with Hospira (2015)	Acquisition of Array BioPharma (2019)	Collaboration with BioNTech on COVID-19 vaccine development (2020)	First mRNA vaccine approval for COVID-19 (Comirnaty)
Moderna		Acquisition of Caperna and other mRNA-based companies	Partnership with Merck on cancer vaccine research (2016)	Breakthrough with the world's second approved mRNA vaccine for COVID-19 (mRNA-1273)
Bristol Myers Squibb	Merger with Celgene (2019)	Acquisition of MyoKardia (2020)	Collaborations with bluebird bio for CAR-T therapies and with Exelixis	Approval of CAR-T therapy Breyanzi for large B-cell lymphoma
Merck	Merger with Schering-Plough (2009)	Acquisition of Acceleron Pharma (2021)	Partnership with Moderna for cancer vaccines	Development of blockbuster cancer drug Keytruda
Lilly		Acquisition of Loxo Oncology (2019)	Collaboration with Boehringer Ingelheim for diabetes treatments	Breakthrough in diabetes with Trulicity and innovative insulin treatments
Johnson & Johnson	Merger with Actelion (2017)	Acquisition of Momenta Pharmaceuticals (2020)	Partnership with Emulate for organ-on-a-chip technology	Breakthrough in oncology with the development of CAR-T therapies for multiple myeloma (Darzalex)

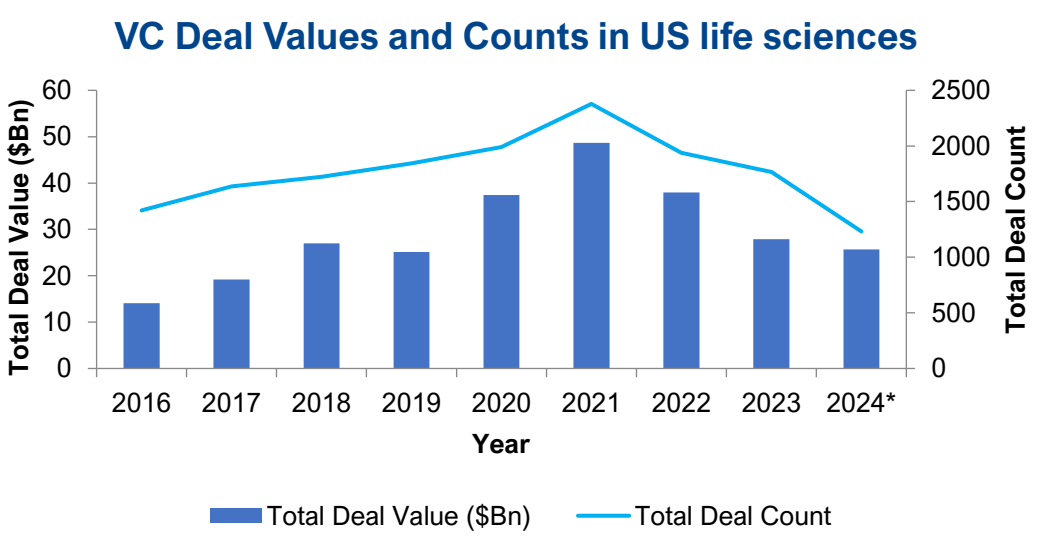
Trailblazers in AI-Enhanced Drug Development: Exploring Key Startups and Their Innovations

Startup	About	Partnerships	Funding	Major Breakthroughs
Verge Genomics	Verge Genomics is a biotechnology company that utilizes AI and machine learning to enhance drug discovery and development, particularly for neurological disorders like Alzheimer's, ALS, and Parkinson's.	In September 2023, Verge entered an AI-Enabled Drug Discovery Collaboration with **Alexion**, part of AstraZeneca Rare Disease.	In December 2021, Verge Genomics raised $98 million with contributions from major investors, including Eli Lilly and Merck.	Verge's candidate drug VRG50635 is notable as one of the first drugs entirely discovered and developed using an AI-enabled platform, specifically targeting Amyotrophic lateral sclerosis (ALS).
Emulate	Emulate, Inc. is a biotechnology company, specializing in organ-on-a-chip technology. This innovative platform mimics human organ systems at a micro-engineered scale, allowing researchers to better understand human biology, disease mechanisms, and the effects of drugs.	Emulate partners with AbbVie to utilize its organ-on-a-chip technology for drug discovery. Its collaboration with Johnson & Johnson aims to integrate this technology into their research pipeline, enhancing preclinical testing and improving drug development efficiency.	In 2018, Emulate raised $50 million with participation from existing investors like Northpond Ventures and The Venture Reality Fund.	Emulate's organ-on-a-chip technology has advanced drug development by improving drug efficacy studies and enhancing the predictability of human responses compared to traditional animal models.
Cellarity	Cellarity aims to revolutionize drug discovery by understanding and leveraging the complexities of cellular biology. The company's proprietary platform integrates advanced cell biology, machine learning, and synthetic biology to identify and develop new therapeutics.	Cellarity partners with Novo Nordisk to develop treatments for Metabolic Steatohepatitis (MASH).This partnership includes potential funding of up to $532 million.	In 2021, Cellarity raised $123 million with participation from investors like Lilly Asia Ventures, Cormorant Asset Management, and Maverick Ventures.	Cellarity Inc. has made significant discoveries, particularly in understanding disease progression in Metabolic Steatohepatitis (MASH) through its collaboration with Novo Nordisk.
Insilico Medicine	Insilico Medicine uses deep learning and generative adversarial networks (GANs) to identify new drug candidates and optimize them, significantly accelerating the drug discovery process.	Insilico has partnered with several major pharmaceutical companies, such as Merck and Johnson & Johnson, to apply its AI technologies to accelerate drug discovery processes and optimize clinical trials.	As of 2021, Insilico Medicine has raised over $300 million in total funding across various rounds.	In 2020, Insilico Medicine successfully identified a novel drug candidate for a specific form of fibrosis within just 18 months using its AI platform.

Through funding, partnerships, regulatory support, data infrastructure, and strategic policies, the US government is actively promoting the use of AI in drug discovery

Funding and Grants	Public-Private Partnerships	Regulatory Support	Data Sharing and Infrastructure	Policy and Strategy
The National Institute of Health launched programs to fund AI research in biomedicine, like the Bridge2AI program to accelerate AI with diverse, high-quality datasets.	The Accelerating Medicines Partnership (AMP), NIH, FDA, and pharma companies use AI and tech to speed up drug development.	The FDA is developing a regulatory framework for AI in healthcare, providing guidance on AI use in drug development and ensuring safety and efficacy.	The NIH-led "All of Us" program aims to create a large, diverse health database for advancing precision medicine and AI-driven drug discovery.	The National AI Initiatives Act of 2020 established a federal program to accelerate AI research and application in sectors like healthcare and drug discovery.
The National Science Foundation funds AI research, promoting collaboration to advance AI in drug discovery and more.	The US government partners with tech companies to leverage AI expertise. The NIH collaborated with IBM Watson Health to apply AI in cancer research.	The Cures Act supports AI in drug development by modernizing clinical trials and patient access to experimental treatments.	The US government has invested in high-performance computing to support AI in drug discovery, including supercomputing resources from the Department of Energy for biomedical research.	National AI Research institutes aim to advance AI in drug discovery and personalized medicine.

VC Investment Trends in US Life Sciences (2016–2024): Key Insights and Growth Patterns



Major VC Deals 2024

Company	Deal Value ($mm)	Date	Key Focus
Xaira Therapeutics	1,000	Apr-24	AI-based drug development
EvolutionaryScale	142	June-24	AI models to generate novel proteins
Hercules CM	400	May-24	Weight loss medicines

- Life sciences venture capital (VC) deal value reached $10.6 billion in Q2 2024, up more than 30% from Q1. In a positive sign for the industry, YTD deal value exceeded that of the year-ago period by 40.2%.
- VC activity in US life sciences surged in the past three years, with about 2,000 deals worth $38 billion in 2022. However, it was down from 2021 levels due to post-pandemic normalization.
- Among the largest deals so far this year, there are several life sciences companies that incorporated AI into their fundamental operations. The technology's potentially transformative applications in areas such as drug discovery and protein design continue to draw in top-tier investment firms and corporate backers.

Source PitchBook • Geography: US *As of September 30, 2024

AI’s Role in Pharma: Turning Complex Challenges into Strategic Opportunities

AI’s impact on pharma: Transforming challenges into opportunities

- **Reduces R&D Costs:** Enhances R&D efficiency by increasing clinical trial success rates by up to 30% (AstraZeneca) and enabling rapid drug discovery
- **Long Drug Development Cycles:** Helps companies like Atomwise screen millions of compounds in days and boosts patient enrollment in trials by 30–40% (IBM Watson)
- **Simplifies Clinical Trials and Protocols:** Reduces patient identification time by 50%
- **Trial Sites:** Enhances site efficiency through automation (Medidata)
- **Patient Compliance:** AI digital health tools raise adherence rates by 20% (2019 study)
- **Patient Care:** DeepMind’s AI diagnoses eye diseases with 94% accuracy, while chatbots enhance patient access to healthcare

Conclusion: The integration of AI into drug discovery presents a transformative opportunity for the pharmaceutical sector, promising accelerated timelines, reduced R&D costs, and enhanced clinical success rates. With a projected CAGR of 10.10% from 2025 to 2034, this market is poised for exponential growth, driven by advancements in AI technology and increasing investment. AI's role in repurposing drugs, optimizing trials, and identifying novel therapeutic targets ensures a compelling value proposition for stakeholders. Leveraging this paradigm shift can unlock significant financial growth, aligning investments with technological innovation and the critical global need for accessible, effective medicines. The time to act is now, capitalizing on this AI-powered revolution in healthcare.

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Connect with our Team

Megha Jalota
Senior Analyst,
Investment Research

+91 124668 9999
megha.jalota@aranca.com

Rohit Dhawan
Senior Manager,
Investment Research

+91 124668 9999
rohit.dhawan@aranca.com

For more details: *www.aranca.com | https://www.linkedin.com/company/aranca | https://www.aranca.com/knowledge-library*

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